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AN ANALYSIS OF THE 2013 HEALTH AND SAFETY AUTHORITY SURVEY

DOROTHY WATSON, OONA KENNY, BERTRAND MAÎTRE AND HELEN RUSSELL

ESRI ECONOMIC & SOCIAL RESEARCH INSTITUTE

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ACRONYMS

ANOVA	Analysis of variation
CSO	Central Statistics Office
ESAW	European Statistics on Accidents at Work
FSPAC	Farm Safety Partnership Advisory Committee
HSA	Health and Safety Authority
LFA	Less-favoured areas
NUTS	Nomenclature of Territorial Units for Statistics
PTO	Power take-off
QNHS	Quarterly National Household Survey
WHO	World Health Organization

GLOSSARY

Analysis of variation (ANOVA)	ANOVA tests the difference between the averages of more than two groups in a sample to determine whether there is likely to be a difference in the population from which the sample was drawn. For example, ANOVA could test whether there is a difference in average scores on a distress scale between farmers in different age groups.
Confidence interval	A confidence interval (CI) is the range within which we can say the population average or proportion falls, at a certain level of confidence (usually 95 per cent confidence). For example, the average age of a sample of farmers may be 40, with a 95% confidence interval of 38 to 42. This means that we can be 95 per cent confident that the average age for the population of farmers lies between 38 and 42. The width of the CI depends on the way the sample was drawn, the sample size, how much variation in age there is in the population and the confidence level.
Confidence level	The confidence level refers to the level of uncertainty we are willing to accept regarding a figure describing a population (e.g. the mean or proportion) that is estimated from a sample of cases from the population. The conventional confidence level in social and economic research is 95 per cent. This means that we seek to be 95 per cent confident (based on sampling methodology, the sample size and the population statistic), that the population average or proportion, for instance, lies within a certain range (see confidence interval, above).
Cronbach's alpha (α)	Cronbach's alpha (α) is a measure of scale reliability. It shows how closely a set of scale items are correlated and ranges from zero to one. A high alpha level is taken as indicating that the items are measuring the same underlying phenomenon. A reliability coefficient or alpha of .70 or higher is considered 'acceptable' in most social science research situations, but scales with a lower reliability are sometimes used (e.g. 0.5 or 0.6) if there are strong reasons for believing that the items capture the same phenomenon.
Deciles	Deciles sort data into ten parts of equal size in terms of some outcome, such as income level or value on a scale. The top income decile, for example, refers to the tenth (or ten per cent) of the population with the highest incomes.

Margin of error	The margin of error tells us the amount of uncertainty there is in inferring a population figure from a sample figure at a given level of confidence (usually 95 per cent). It is a different way of expressing the confidence interval and is half the width of the confidence interval. In the example, above under 'confidence interval', the margin of error at the 95 per cent confidence level is plus or minus two years.
Multivariate analysis/ statistical models	A statistical analysis methodology used to examine the impact of one factor (such as gender) on another (such as hourly earnings), after taking account of other differences (such as education and work experience). For instance, multivariate analysis would allow us to ask whether men's hourly earnings are higher than those of women, because of differences in factors such as education or work experience, or whether there is still a difference even when we take account of these factors.
Odds ratio (OR)	This is an indicator of how much more or less likely an outcome is for one group compared to another. An odds ratio greater than one indicates a greater likelihood, while an odds ratio of less than one indicates a lower likelihood. For instance, if the odds ratio for being employed is 1.5 for men compared to women (reference category), then men have 1.5 times the odds (or a 50 per cent higher chance) of being employed when compared to women.
Pearson correlation (r)	The Pearson correlation is a measure of the strength of a linear association between two variables, such as age and income. The correlation varies between zero and plus or minus one, where the closer the value is to zero, the weaker the association. A negative correlation means that as one variable increases, the other tends to decrease. A positive correlation indicates that as one variable increases, the other also tends to increase. We cannot conclude that one variable causes change in another because they are correlated.
Stata	Stata is an integrated statistical package used for data management and analysis.
Statistical significance and p-values	In research, statistical significance is associated with a test of a hypothesis (or expectation) about a specific figure in the population using information from a sample of the population. For example, our hypothesis might be that there is a difference in the average age between two groups. Conventionally, most statistical software sets up the statistical test to test the 'null hypothesis' of no relationship or no difference between groups. The p-value of the statistical text indicates how likely it is that we would find a

statistic of this size in our sample (e.g. the average age difference we see in the sample) if there were no difference in the population. The p-value ranges from zero to one. The lower the value, the less likely it is that the null hypothesis is true. At the conventional 95% significance level, a p-value of less than 5 per cent (or .05) is regarded as statistically significant. It means we can be 95 per cent confident that we would not find a difference this large in the sample if the null hypothesis of no difference were true.

The calculation of the p-value takes account of the way the sample was selected, the sample size and how variable the population is in terms of the aspect of interest (e.g. age). Conventionally, p-values are reported in the following form: $p < .05$ corresponding to the 95 per cent confidence level and $p < .01$ for the 99 per cent confidence level.

Teagasc — The Agriculture and Food Development Authority is the Irish national body providing integrated research, advisory and training services to the agriculture and food industry and rural communities.

T-tests — A t-test is commonly used to assess whether we can be confident that there is a difference between the averages for two groups in a population, based on what we find in a sample taken from that population. A p-value (see above) is reported in connection with a t-test to indicate the likelihood that there is no difference between the groups in the population given what we observe in the sample.

EXECUTIVE SUMMARY

BACKGROUND

The agricultural, fishing and forestry sector in Ireland has the highest rate of both fatal and non-fatal work-related injuries compared to other sectors (Health and Safety Authority (HSA), 2016). The HSA commissioned a 2013 nationwide research study to examine farm safety issues. That study involved a postal survey of farmers selected at random from the HSA database of farms, with a small booster sample of questionnaires completed by face-to-face interview at marts. Findings were presented in a report focusing on descriptive results regarding intentions to work safely, published in 2014 (HSA, 2014).

The present study involves an in-depth analysis of the same survey data, but goes beyond the original report in calibrating the data to represent all farms and conducting detailed statistical analysis to identify the most important factors related to risk taking and how this is linked to accidents on farms.

RESEARCH QUESTIONS

The main research questions are:

- Does risk taking vary with the characteristics of the farmer (age, marital status, full-time or part-time work status, number of years farming experience) and of the farm (farm size, farm type)?
- Do work stress and levels of distress differ by farmer and farm characteristics? Are work stress and levels of distress associated with risk taking?
- How do farmer and farm characteristics and risk taking influence farm accidents or 'near misses'?

RISK TAKING

Risk taking was measured in terms of failing to routinely take six different safety precautions:

- using safety gear (such as goggles, ear defenders);
- using restraining or handling facilities when treating animals;
- checking that machinery is in good working order;
- using power take-off (PTO) or machinery guards;
- keeping chemicals stored away from access by children; and
- getting help with difficult jobs.

The most common risks taken were 'not routinely getting help with difficult jobs' (27 per cent) and 'not routinely using safety gear' (26 per cent). About 11 per

cent of farmers did not check machinery before use and 12 per cent did not routinely use PTO guards. Risks involving animals and improper storage of chemicals were each taken by fewer than one in ten of the farmer respondents.

An overall indicator identified farmers who were in the highest ten per cent of risk taking, based on a scale incorporating the six types of risk. Younger farmers and dairy farmers showed higher levels of risk taking on this scale and risk taking tended to be lower on the smallest farms. A statistical model (see Chapter 3) that took account of a number of factors at once pointed to farm type as the main factor, with a higher probability of being a risk-taker on dairy farms. There was also a tendency for the younger farmers to be risk-takers, though this was only of borderline statistical significance when farm type was taken into account.

Different types of risk

We also examined the different types of risk separately in a statistical model that included farmer age, marital status, presence of children, farm size, farm type (dairy or not) and whether working part-time or full-time.

Age

Differences by age were small and only borderline statistically significant.

Marital status

Single farmers were more likely to take risks in not checking machinery before use but did not differ from their married counterparts on the other types of risk.

Children

There were no differences between farmers with and without children when we controlled for marital status, age and farm type.

Farm size

Differences by farm size were statistically significant for two of the six types of risk. Those farming a higher number of hectares were more likely to not use safety gear but were less likely to tackle difficult jobs without getting help. For instance, compared to farms under 20 hectares, the odds of not using safety gear were over twice as high on farms more than 50 hectares, which could either reflect the greater amount of work on large farms or the distance from where safety equipment was stored. On farms more than 100 hectares, the odds of not getting help were only about one-third as high as on farms under 20 hectares.

All of the farmers in the study were self-employed with no regular employees. However, larger farmers may have been better able to afford to hire help, either on a part-time or seasonal basis.

Employment type

Part-time farmers showed some tendency to have a higher rate of risk taking but this was only statistically significant for improper storage of chemicals, where the odds were nearly four times higher than for full-time farmers. It is also in terms of improper storage of chemicals that dairy farmers stand out, with odds that are over six times higher than for non-dairy farmers. However, the overall proportion of farmers taking risks in this respect is low, in both the dairy and non-dairy sectors.

DISTRESS AND STRESS

In general, farmers reported low levels of distress and a medium level of concern regarding work issues. Distress was measured using the World Health Organization's five-item Well-Being Measure (WHO-5). This measure is used to establish how often in the previous two weeks the farmer had felt cheerful, calm and relaxed, active and vigorous, rested in the morning and that life was filled with things of interest. On a scale ranging from 0 (low distress–high well-being) to 5 (high distress–low well-being), the average score was towards the low end of the scale, at 1.5.

Work-related stress was measured on the basis of level of concern regarding government regulation, farm paperwork, financial matters and workload. Using these four items, we constructed a scale to assess farmer's levels of concern associated with these areas. A scale ranging from 1 (low stress) to 5 (high stress) was constructed, with the average score falling towards the middle, at 3.35.

No firm conclusions on relationship between risk taking and distress or stress

Although some previous research had suggested a link between risk taking and stress or distress, we did not see this pattern in the present data for the overall indicator of risk taking, once we took account of farmer and farm characteristics.

However, we found that distress was related to two of the specific types of risk. Where the farmer had high levels of distress, the odds of improperly storing chemicals were five times higher and the odds of not getting help with difficult tasks were nearly three times higher. We cannot draw firm conclusions about the direction of causation here, since both distress and the ability to get help were measured at the same point in time. Farmer distress may be due to not having someone to call on for help or it may be that farmers experiencing distress are more reluctant to ask for help.

ACCIDENTS AND NEAR MISSES

Farmers were asked whether they or someone else had experienced an accident on their own farm in the previous ten years or whether they had personally experienced a near miss. Overall, 12 per cent of farmers were personally involved in an accident, 27 per cent had had a near miss and 8 per cent reported that someone else had been involved in an accident on their farm. Note that because of the way the farms for the study were selected (including a small booster sample from regions with a high fatality rate), the rate of accidents or near misses on the farms may be somewhat higher than the overall rate across all farms.[1]

In about half of the cases where an accident occurred, the accident resulted in four or more days lost from work. Although we have no information on the potential severity of the near misses, the fact that over one-third of the studied farms were affected by at least one of these types of incident over a ten-year period points to the dangers inherent in farm work.

What factors are associated with an accident or near miss?

We drew on a statistical model to examine the link between accidents and the farmer and farm characteristics, as well as risk taking. The clearest results were found when we distinguished between types of incident and types of risk taking. Farmer accidents and near misses were both associated with larger farms. In terms of safety practices, not getting help was strongly associated with both accidents and near misses involving the farmer. Not checking machinery was significantly associated with accidents involving others and with near misses involving the farmer. Since about half of the farmers who had experienced an accident reported subsequently changing something on the farm, the association between risk taking and having experienced an accident is weaker than if we had a measure of behaviour at the time of the accident.

When other factors, including risk taking, are controlled, there was no association between the occurrence of these incidents (accidents or near misses) and farmer age, family circumstances and farm type. There was a small tendency for part-time farmers to be more likely to report near misses but no significant relationship to actual accidents.

LIMITATIONS AND FURTHER RESEARCH

The main limitation in this research was the cross-sectional design, which warrants caution in inferring causal relationships. In addition, the need for

[1] Although the data were reweighted to take account of representativeness by farm type (dairy or not), farm size and farmer age, no reweighting by region was possible because this was not recorded in the survey data.

sample weights restricted the power of statistical tests to detect patterns as statistically significant. However, these weights were necessary due to a low representation of small farms and non-dairy farms.

POLICY IMPLICATIONS

This study involved re-analysing data on farm practices in order to draw out insights that may be relevant for policy. It points to a number of possible implications for health and safety policy and practice on farms.

Getting help with difficult tasks

Given the solitary nature of much farm work, there is clearly a need for a system that enables farmers to call on additional help during a difficult task. Over one-quarter of farmers do not routinely get help when tackling difficult tasks and this form of risk taking is strongly associated with having an accident or near miss. More information is needed on the type of tasks involved and on their frequency in order to develop more specific recommendations in this area.

Checking machinery

Safety messages need to continue to emphasise checking machinery before use. Failure to do so is associated with an increased incidence of accidents involving others and near misses. Although less common than not getting help, this risk is taken by about one in eight farmers.

Younger farmers

Younger farmers were more likely to take risks, mainly because of the association between age and farm size and type. This points to the need to have safety messages directed towards young farmers in areas such as use of safety gear, checking machinery, using PTO guards and getting help with difficult tasks. Since young farmers are likely to have taken agricultural training courses, these aspects of health and safety might be further emphasised as part of their training.

Storage of chemicals

Safety messages on proper storage of chemicals could usefully be directed to dairy farmers who are more likely to take risks in this respect.

Larger farms

Larger farms are associated with a greater risk of accidents and near misses involving the farmer, even controlling for other characteristics and risk taking. The reasons are not clear from this study and should be examined further. It may be related to the amount of work to be done on the farm or to the distance that needs to be travelled to get safety equipment.

New ways of reaching farmers

It is worth examining a range of options for disseminating safety messages to farmers. These include collaborating with farm insurers to make more use of the insurance discounts that insurers offer to farmers who complete a safety checklist; linking discounts to taking a farm safety 'refresher' course and disseminating research on farm safety in a non-technical, accessible format.

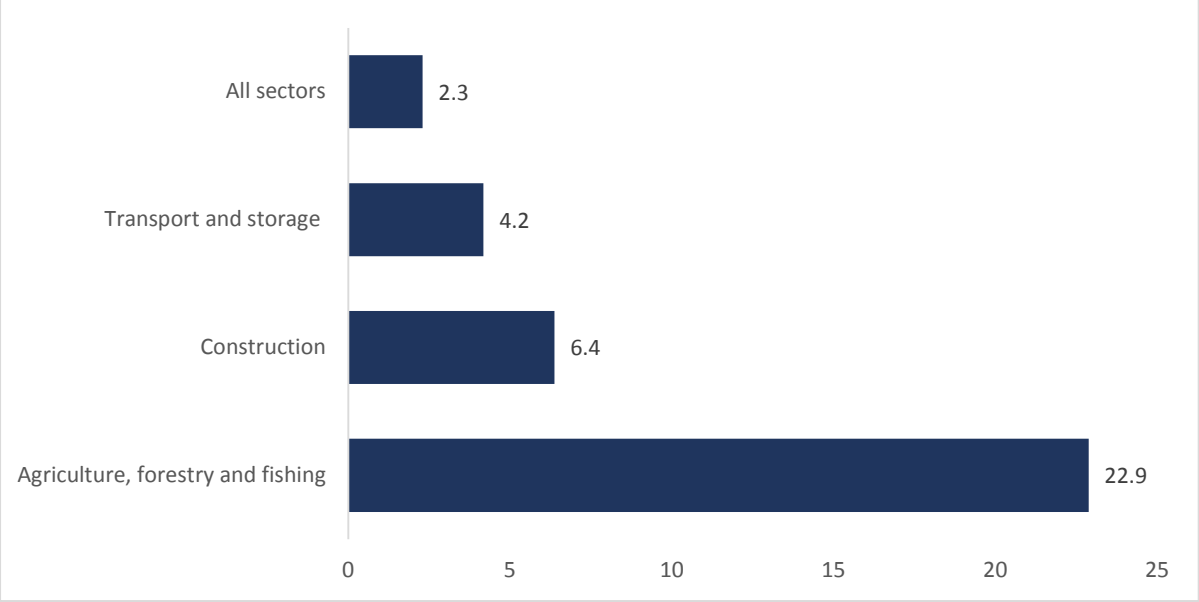
CHAPTER 1

Introduction

1.1 BACKGROUND AND RATIONALE FOR THIS STUDY

The agricultural, fishing and forestry sector in Ireland has the highest rate of fatal injuries across sectors, with a rate that is ten times higher than the overall rate (Health and Safety Authority (HSA), 2016). The rate of work-related fatalities per 100,000 workers across all sectors from 2009 to 2015 was 2.3 but in agriculture, fishing and forestry this rate was ten times higher, at 23 per 100,000 workers, with the majority of these occurring in agriculture (Figure 1.1). In 2015, almost one-third (32 per cent) of all worker fatalities reported to the HSA occurred in the agricultural sector alone while in 2014, in this regard the worst year for over 25 years, the proportion was 54 per cent (HSA, 2016).

FIGURE 1.1 WORKER FATALITIES PER 100,000 WORKERS, SELECTED SECTORS, AVERAGE 2009–2015



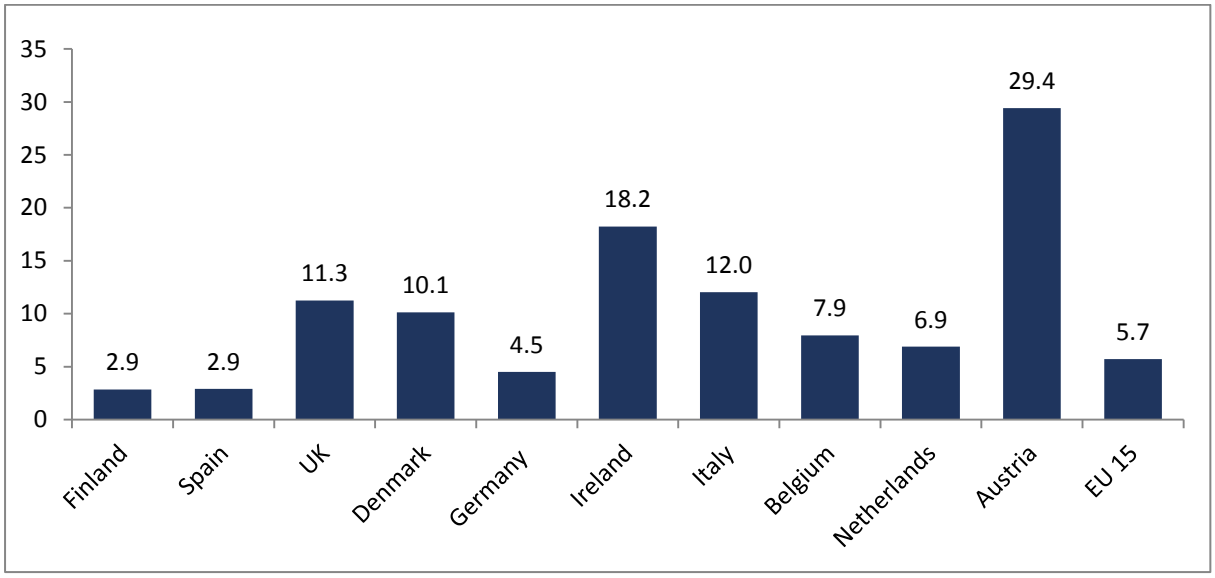
Source: Authors' analysis using HSA work-related fatalities dataset. Rates are per 100,000 workers, not adjusted for hours worked.

In their analysis of worker fatality rates, Russell et al. (2015) find that, compared to the service sector, the risk of fatal injury is more than 24 times higher for the agricultural sector ($p<.000$).[2] Furthermore, the analysis of trends over time shows that the rate of fatalities in the agricultural sector has increased significantly between 2004 and 2011 while the rate in the industry and construction sectors has not changed significantly.

[2] Using data from the Health and Safety Authority (HSA) for the period between 2004 and 2011.

A European comparison, based on Eurostat data on fatalities in the agricultural sector, is shown in Figure 1.2. The figure focuses on a set of ten EU15 countries for which we have data for the years 2008 and 2013 and shows the annual average number of fatalities per 100,000 workers in agriculture over the period. Ireland had the second highest rate of fatalities in agriculture in the period, at 18.2 per 100,000 workers per year compared to an average figure of 5.7 across the EU15 countries.

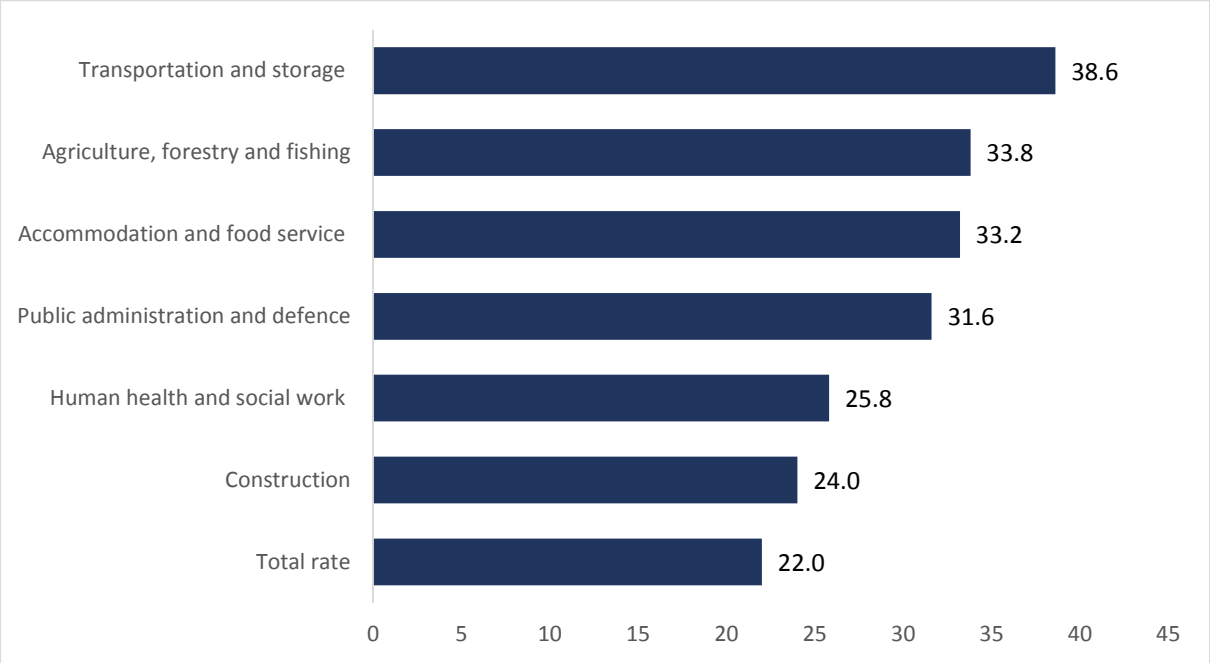
FIGURE 1.2 WORKER FATALITIES PER 100,000 WORKERS IN THE AGRICULTURAL SECTOR, ANNUAL AVERAGE 2008–2013



Source: European Statistics on Accidents at Work (ESAW) tabular data from Eurostat website (hsw_n2_02); Crop and animal production, hunting and related service activities; last updated 23 November 2016.

In addition to high fatality rates, the agricultural, fishing and forestry sector has one of the highest rates of non-fatal work-related injury compared to other sectors. While the worker fatality rate in the agricultural sector is, and has generally remained, much higher compared to other economic sectors (see Figure 1.1), the rate of non-fatal injury in this sector has tended to fluctuate (HSA, 2016). However, Figure 1.3 shows that this sector had the second highest average rate of injuries causing any days off work between 2010 and 2014 (34 per 1,000 workers compared to a rate of 22 across all sectors). In 2014, the most recent year for which figures are available, 51 per 1,000 workers from the agricultural, fishing and forestry sector reported a work-related injury, making it the sector with the highest rate of non-fatal injuries for that year (HSA, 2016).

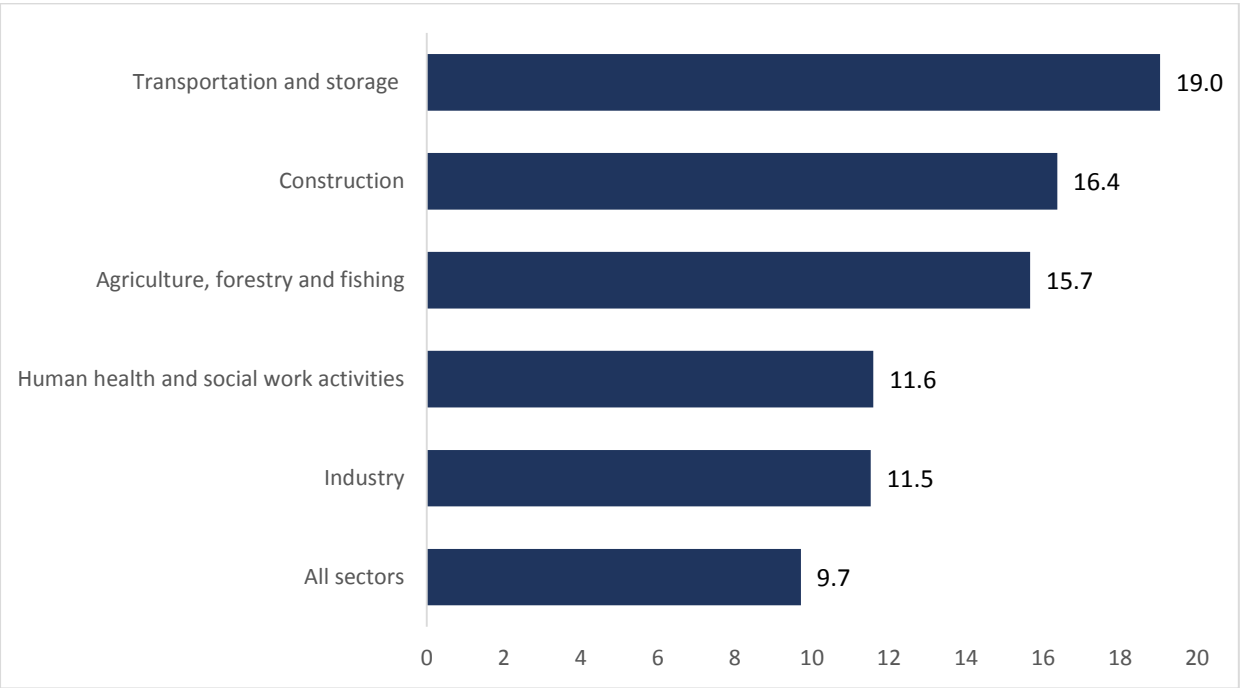
FIGURE 1.3 RATE OF INJURY (ANY DAYS LOST) PER 1,000 WORKERS, SELECTED SECTORS, 2010 – 2014



Source: Authors' analysis of data from the QNHS special module on work-related accidents and illnesses (CSO).
Note: The total rate in the chart includes all sectors, not just the selected sectors shown.

From 2010 to 2014, this sector accounted for one of the highest rates of worker injury resulting in four or more days off work (15.7 per 1,000 workers compared to a rate of 9.7 in all sectors). This rate has been rising since 2011 (HSA, 2016).

FIGURE 1.4 RATE OF INJURIES PER 1,000 WORKERS WITH 4+ DAYS LOST, SELECTED SECTORS, 2010–2014



Source: Authors' analysis of data from the QNHS special module on work-related accidents and Illnesses (CSO).

The high level of injury and fatalities in the farm sector is the main motivating factor for this present study. In the remainder of this chapter, we review previous research on the farm sector, including the HSA's 2013 survey of farms, which we re-analyse in the present report. We outline the research questions and discuss the data and methodology in the present analysis.

1.2 PREVIOUS RESEARCH ON THE FARM SECTOR

1.2.1 Rates and risks

Finnegan and Phelan (2003) and McNamara (2012) report findings from a nationally representative survey of farms showing that injuries per 100,000 farms fell from 3,077 in 2001 to 1,815 in 2006, but that there was a 35 per cent increase between 2006 and 2011, which a rate of 2,459 reported injuries per 100,000 farms in 2011.[3] Analysis by Russell et al. (2015) indicates that the risk of injury for workers in the agricultural sector is 1.9 times higher ($p<.000$) compared to those in the services sector, even when worker characteristics, such as gender, age, nationality and self-employment, and job factors, such as hours and tenure, are controlled for. Similarly, Watson et al. (2015) found that across 34 European countries, exposure to physical risk in the workplace was nearly 1 point higher on a scale of 1 to 10 (.97, $p<0.01$) and exposure to physically demanding work was nearly half a point higher (.41, $p<0.05$) in the agricultural, forestry and fishing sector than in the retail and wholesale sectors, controlling for job and worker characteristics. These differences are substantial compared to the average level of exposure across countries, which was about 1.3 on the ten-point scale for both physical risk and physically demanding work.[4]

1.2.2 Reasons for high injury and fatality rates

The high injury and fatality rates in agriculture can be explained to some extent by the hazardous nature of agricultural work and potential dangers present in the farm environment. For example, McNamara and Reidy (1997) point to the high number of wide-ranging tasks that have to be carried out in various locations of the farm and the presence of potentially dangerous animals, machinery, farm buildings and equipment as possible risk factors in injury and fatality. Statistics from the Health and Safety Authority in Ireland (HSA) show that from 2006 to 2015, 29 per cent of deaths in the agricultural sector were caused by tractors and farm vehicles and 19 per cent by machinery. A further 17 per cent of fatal

[3] From the 2011 farm safety module carried out every five years as part of the National Farm Survey conducted annually by Teagasc (n=995 farmers representative of the national farming population by farm system and farm size above two acres, but excluding pig and poultry farms).

[4] Physical risk includes vibration from tools and machinery, loud noise and extremes of temperature. Physically demanding work includes that requiring a painful or tiring position, lifting or moving people, carrying or moving heavy loads, and repetitive hand or arm movements.

accidents are attributed to falls from a height, falling objects and collapses and a further 14 per cent to livestock, in particular cows and bulls.[5] On average, since 1991, data from the Teagasc Farm Safety Survey shows that trips and falls constitute the most common cause of non-fatal injury on farms (at 42 per cent), followed by livestock (33 per cent) and vehicles and machinery (11 per cent).[6] This is consistent with international findings (Solomon, 2002; McCurdy and Carroll, 2004; Rautiainen et al., 2004).

1.2.3 Differences in risk within the farm sector

Farmers do not make up a homogenous group, however, and several studies have pointed to differences in risk within the farm sector by farmer or farm work characteristics. Several studies from the US have found links between the incidence of injury and farm characteristics. For example, McCurdy and Carroll (2000) reviewed a large number of US-based studies showing that injury is more common on smaller and larger farms. Many of the studies reviewed reported that beef and dairy farmers and those with more machinery and farm vehicles present were more likely to be injured.

Similarly, very young and much older farmers reported more injuries, a finding which suggests a risk for both inexperience and frailty, while older farmers had a higher risk of work-related fatality. Other findings include an increased chance of injury for farm owners and resident farmers and those working more or longer hours. Risk was reported by some studies to rise in the spring and autumn seasons and participation in safety courses did not lead to a reduction (see McCurdy and Carroll, 2000).

Sprince et al. (2002) report that more hours per week spent on farm work and fewer years of farming experience increase the risk of machine-related injury, while older farmers (aged 40–64 years compared to 22–39 years) were found to be less likely to sustain an animal-related injury.[7] Virtanen et al. (2003) report an increase in the risk of injury as the number of dairy cows increases. They suggest that the following factors cause such injuries: the size of the dairy cows, unanticipated behaviour and the posture required by farmers caring for them.

[5] http://www.hsa.ie/eng/Your_Industry/Agriculture_Forestry/Further_Information/Fatal_Accidents/

[6] Based on survey data from the years 1991, 1996, 2001 and 2011. The survey conducted in 2006 is omitted as it included injury reports for one year rather than five years.

[7] Working more hours per week is associated with a higher risk of injury and illness in many sectors (Dembe et al., 2005; Russell et al., 2015). However, making an adjustment to account for those who work more or less hours than the standard working week allows an estimate of exposure to workplace risks per hour work. Using this adjustment other studies find that those working a shorter number of hours per week have a higher risk per hour worked (Davies and Jones, 2005; Russell et al., 2015).

In Ireland, Furey et al. (2016) cite McNamara's (2010) finding that 58 per cent of farm fatalities between 2000 and 2007 occurred on dairy farms despite these farm types constituting only 11 per cent of all Irish farms (CSO, 2014). Dairy farming is typically carried out on medium-sized farms: 74.4 per cent of dairy farms are between 30 and 99 hectares (Teagasc, 2013).

1.2.4 Specific aspects of work in agriculture

Workers in the agricultural sector are unique compared to those in many other sectors. CSO QNHS figures for Quarter 1 (Q1) 2015 show that the rate of self-employment is highest in the agricultural, forestry and fishing sector (74 per cent). This can be compared to the next highest sector, construction, where the self-employment rate is 37 per cent, compared to an overall rate of self-employment across all sectors of 17 per cent (CSO, 2015). According to the CSO Farm Survey 2013, of the 139,600 farms in Ireland, 99.6 per cent were classified as family farms. Over 88 per cent of family farm-holders were male and while only 5.9 per cent of these farmers were aged under 35 years, more than half (53 per cent) were aged 55 years or over, with 27 per cent of all family farm-holders aged 65 years or over (CSO, 2014).

1.2.5 Different attitudes and behaviours

There are concerns that workers in agriculture may have different attitudes and behaviours in relation to safe working practices. For example, despite having generally positive attitudes to health and safety and regulation on the farm, studies have shown a low implementation rate of safety measures among Irish farmers (Finnegan and Phelan, 2003; McNamara and Reidy, 1997). This finding is also reported in studies from the UK (Knowles, 2002; HSE, 2009). Farmers may have a propensity for higher risk taking stemming from a number of factors including: a culture of 'masculinity' (Roy et al., 2014), resistance to change among rural communities and the nature of self-employment (McNamara, 2014).

1.2.6 Stress and distress among farmers

There is some evidence that farmers are likely to experience higher levels of stress (Simpson et al., 1995; Deary et al., 1997; Kolstrup et al., 2013; Furey et al., 2016) and mental or emotional distress (Roberts and Sul Lee, 1993; Wallis and Dollard, 2008; Beseler and Stallones, 2010). This may be linked to work safety outcomes. In the US, Roberts and Sul Lee (1993) found that compared to executives, farmers had a 21 per cent higher risk of major depressive illness,[8] both in the six months prior to their study and over their lifetime, after taking

[8] As per the DSM-111 diagnostic criteria. To qualify as a case of major depression, a spell of two or more weeks of sadness had to be reported, accompanied by symptoms in four or more of the following: appetite, sleep, fatigue, slowing of bodily movements/thought, feeling worthless, loss of pleasure, difficulty concentrating and suicidal thoughts/desires/attempts.

account of gender, age and education. A Norwegian study reports that farmers (both full-time and part-time) had significantly higher levels of depression compared to non-farmers in both genders, and significantly higher levels of anxiety in male farmers.[9] Levels of both anxiety and depression were highest among male livestock farmers (Sanne et al., 2004).

Much of the literature on farmer distress and stress focuses on dairy farming. For example, Wallis and Dollard (2008) found that Australian dairy farmers had significantly higher levels of psychological distress[10] compared to eight other Australian occupational groups, including correctional officers, private sector workers, family and community service workers, nurses and Salvation Army officers, and that almost half of the dairy farmers had at least mild distress. Deary et al. (1997) found more time-pressure-related stress among dairy farmers compared to cereal farmers and higher levels of financial stress among 'less-favoured areas' (LFA) cattle and sheep farmers compared to dairy and cereal farmers.[11] Older farmers were found to have lower levels of stress in the areas of finance, time pressure, isolation, personal hazards and 'acts of God'.

In a review of international literature, Kolstrup et al., (2013) cite the following as dairy farm stressors:

- bad weather;
- fluctuating markets;
- government regulations;
- social and environmental responsibilities;
- disease outbreaks;
- taxes related to dairy production; and
- recent negative societal attitudes to farming in general.

The authors also note that higher work demands and expectations, along with less influence and control over external conditions, demands and lack of social support, can lead to increased stress levels, poorer mental health and depression, and even suicide.

1.2.7 Little research on stress or depression and farm safety

Very few studies have investigated the relationship between stress or depression and farm safety behaviour. However, a study in Colorado, US, using logistic

[9] Assessed via the Hospital Anxiety and Depression Scale (HADS), a well-validated scale containing two subscales of seven items, each measuring both anxiety (HADS-A) and depression (HADS-D).
[10] Measured using the General Health Questionnaire (GHQ)-12, a validated measure of psychological distress or strain with questions such as "Have you recently been able to concentrate on whatever you're doing?"
[11] 'Less-favoured areas' (LFA) is a term used in the European Union for poorer farm areas in terms of climate, soil and terrain (see http://ec.europa.eu/agriculture/rural-development-previous/2007-2013/less-favoured-areas-scheme_en)

regression analysis and controlling for age and gender, shows that depressed farmers reported significantly higher levels of 'high-risk' safety behaviour (Beseler and Stallones, 2010). [12, 13] This study found that depression was significantly associated with rarely or never exercising the following safety practices: being calm around animals; using restraining and handling facilities for treating animals; reading instruction manuals for farm machinery; keeping moving equipment parts shielded. The following safety practices were not significantly associated with depression: replacing protective shields after working on equipment; keeping chemicals out of the reach of children; keeping passageways clear of slippery substances and using a respirator; wearing a dust mask; and hearing protection. On a related issue, Furey et al. (2016) found that Irish dairy farmers with higher levels of 'farm stress' were significantly more likely to express 'expectations of injury'.[14,15]

1.3 THE HSA FARM STUDY

In 2013, the HSA commissioned a research study to examine farm safety issues (see HSA, 2014). The survey provided data from 836 self-employed male farmers (see section 1.5 for methodology). Its questionnaire included demographic information on the farmer and the farm, attitudes, beliefs and behaviour around farm safety, accident involvement and psychosocial factors (for example well-being, stress and performance-influencing factors). Analysis of the data collected was mainly descriptive in that only the percentages and frequencies of responses to items were reported. Findings showed that having the right tools or equipment and general tiredness ranked as the highest influencing factors regarding farmers' ability to work safely and efficiently. In terms of work stress, government regulations, bad weather and paperwork caused most concern.

While farmers' well-being was generally good, eight per cent were found to have 'low mood' and a further six per cent were depressed in terms of the WHO-5 scale rating. Mean scores showed that farmers' attitudes and intentions to work safely, and their actual safe working behaviour were generally positive. Farmers were influenced by subjective norms around safety (for example, they felt people important to them expected them to work safely), but their level of perceived

[12] According to the Center for Epidemiologic Studies-Depression (CES-D) scale, which is often used to research the health correlates of depressive symptoms. Respondents were asked how many times over the past week they had experienced symptoms of depression.
[13] Respondents were asked to report five possible responses to how often they engaged in specific farm safety practices. These were dichotomised into low risk ('all of the time', 'most of the time') and high risk ('sometimes or occasionally', 'rarely', and 'never').
[14] Measured using the Edinburgh Farming Stress Inventory. (Deary et al., 1997).
[15] Measured using the six-item 'susceptibility to a farm related accident/illness' subscale, which is a factor of the established Farm Safety and Health Beliefs Scale (FSHBS). Items include, for example, 'I'm more likely than the average farmer to have a farm-related accident or illness'.

control over the ability to work safely was low for some items. In the ten years prior to the survey, 17 per cent of respondents had been personally involved in an accident and in eight per cent of cases, someone else had been injured on the farm.

1.3.1 Statistical tests

Statistical enquiry was largely confined to tests of the strength and significance of a relationship between two factors or differences between groups, using t-tests and analysis of variation (ANOVA).

The findings from these tests showed that younger farmers expressed lower intentions to work safely and were less likely to be influenced by the safe working expectations of others (subjective norms), while married farmers scored higher on these factors. Farmers who had more years of farming experience were more likely to report higher intentions to work safely, to be more influenced by the safety expectations of others and to engage in safe working behaviour. Those who reported not being involved in an accident in the previous ten years were more likely to be influenced by the expectations of others, to have stronger intentions to work safely and a greater sense of control over their ability to work safely (perceived behavioural control), to engage in safer working practices and to have a smaller farm.

Multiple regression analysis can help us explore how several independent or predictor variables can influence a dependent or outcome variable. In the HSA farm study this type of analysis was used only to explore how attitudes, subjective norms and perceived behavioural control interacted with farmers' intentions to work safely. Results from this model indicated that subjective norms had the greatest influence on intentions to work safely. Attitudes to safe working exerted a smaller influence, while perceived control was found to not be a significant predictor of intentions to work safely. The study reports that intentions to work safely are correlated with actual safe working practices; while perceived behavioural control does not predict intentions to work safely, it is directly correlated with safe working practices.

1.4 RESEARCH QUESTIONS FOR THIS STUDY

This report builds on the HSA farm study by presenting the results of further analysis of the survey data. Using statistical modelling techniques and controlling for individual and farm characteristics, we explore the interrelationship between safe work practices and risk of experiencing an accident on a farm, and how these may be linked to contributing factors such as work stress, beliefs and attitudes to safe working practice. Specifically, we ask:

- Does farmers' risk taking vary with the characteristics of the farmer (age, marital status, full-time or part-time work status, number of years farming experience) and of the farm (farm size, farm type)?
- Are work stress and levels of distress associated with risky behaviours?
- What is the association between these factors (characteristics of the farmer and farm, risky work practices) on farm accidents or 'near misses' in the previous ten years?

The findings provide evidence to guide policy around farm safety by identifying areas where action can be taken to improve safe working practice and reduce the risk of accidents.

1.5 METHODOLOGY

1.5.1 The data

The HSA commissioned GL Noble Denton, an independent risk management consultancy firm, to carry out a research project that would allow further understanding of the attitudes, behaviours and related factors that contribute to safe and unsafe working practices among Irish farmers (see HSA, 2014). This was achieved through a survey of 836 male, self-employed farmers.

The gross sample of 3,048 self-employed farmers with no regular employees was drawn at random from the HSA database of all farms (7,750 in total) that had been inspected by HSA inspectors between January 2009 and June 2013. The sample was a systematic random sample, stratified by the NUTS3 regions.[16] Of the 7,750 farms added to the database, 5,866 (or 76 per cent) were listed as self-employed with no employees. A total of 787 interviews were completed through a postal survey of the sample of 3,048 farmers, representing a response rate of 26 per cent.

A small number of additional interviews (49) were completed by face-to-face interview at two large farmers' marts in Thurles, County Tipperary and Bandon, County Cork. These locations were chosen because they were large marts, with a high farmer attendance, and located in regions with a high fatality rate. Purposive sampling was used to select farmers who were male, self-employed, a main farm owner, actively involved in the farm work and who did not employ any full-time workers. The face-to-face interviews were carried out in June 2013 during one full day at each mart, with €10 paid to farmers who agreed to take part.

[16] None of the farms in the HSA database were added as a result of a reported accident. Visits by inspectors in response to accidents are treated separately as investigations. Investigations were excluded purposely to avoid surveying farms where a fatality had occurred.

These booster interviews – amounting to about six per cent of the total sample – were selected from regions with a higher accident rate. This means that the overall estimate of accident occurrence in the data may be higher than the national average. As discussed below, the data were reweighted to take account of representativeness by farm type (dairy or not), farm size and age of farmer, but no reweighting by region was possible because the region was not recorded in the survey data.

The questionnaire included items on safe working practices, attitudes to working safely, factors that influence or create barriers to safe working and the occurrence of accidents on the farm. It also had items measuring levels of work-related stress and well-being, along with demographic information relating to characteristics of both the farm and the farmer. The questionnaire was developed following an extensive literature review and feedback from workshops involving farmers and stakeholders. The stakeholders included the HSA, the Farm Safety Partnership Advisory Committee (FSPAC) and Teagasc – the agency that provides integrated research, advisory and training services to the agriculture and food industry and rural communities.

The same questionnaire was used in the face-to-face interviews and the postal survey, though three additional sections were added to it for the face-to-face interviews, on well-being, work efficiency and general safety behaviours. The postal questionnaire was distributed to an initial sample of 3,048 farmers randomly selected from the HSA's farm holdings database and stratified by NUTS region.[17] Farmers were asked to complete the postal survey between 8 and 31 of July 2013 and were given the option of providing an email or phone number so that they could be entered into a prize draw. A total of 802 completed surveys were returned to the HSA. From this, 787 were usable; this represents a 26 per cent response rate. Together with the 49 face-to-face interviews, there was a total of 836 cases for data analysis.

1.5.2 The completed sample and sample weighting

In order to ensure that the HSA survey was representative of all farms, we compared key characteristics with known characteristics of the general farming population taken from the 2010 Census of Agriculture (CSO, 2012) and the 2013

[17] The Nomenclature of Territorial Units for Statistics (NUTS) were drawn up by Eurostat in order to define territorial units for the production of regional statistics across the European Union. The Irish NUTS 3 regions comprise the eight regional authorities established under the Local Government Act, 1991 (Regional Authorities) (Establishment) Order as follows; Border, Midlands, West, Mid-west, South-west, South-east, Mid-east and Dublin (see http://www.cso.ie/en/census/census2011boundaryfiles/).

Farm Structure Survey (CSO, 2014). The Census of Agriculture is carried out across the EU to collect data on all farms in each country about every ten years and is supplemented by the Farm Structure Survey, which is carried out every two to three years. The most recent agricultural census was carried out in 2010 and the most recent Farm Structure Survey in 2013. The Farm Structure Survey sample is selected using a ten-stage selection process from data on the CSO Agricultural Register, with 100 per cent of farms selected in some instances so that the survey is representative of farms in terms of size, economic output, farm type, new farms and region.[18]

The comparison indicated that the samples differed on some demographics. Farmers from the HSA sample tended to be younger, to work on larger farms and were less likely to work part-time. Comparison of farm type between the CSO and HSA samples is difficult because of the different classifications used. However, the majority of the HSA sample was involved in dairy or dairy and other farming and sucker cattle or dry stock cattle. This corresponds to a prevalence of beef production followed by dairy, sheep and mixed grazing livestock in the CSO sample.

To make sure that the results were representative of the population of farms, we reweighted the HSA survey data on the basis of farmer age, farm size and farm type (dairy or other type) to match the figures from the CSO's 2013 Farm Structure Survey.

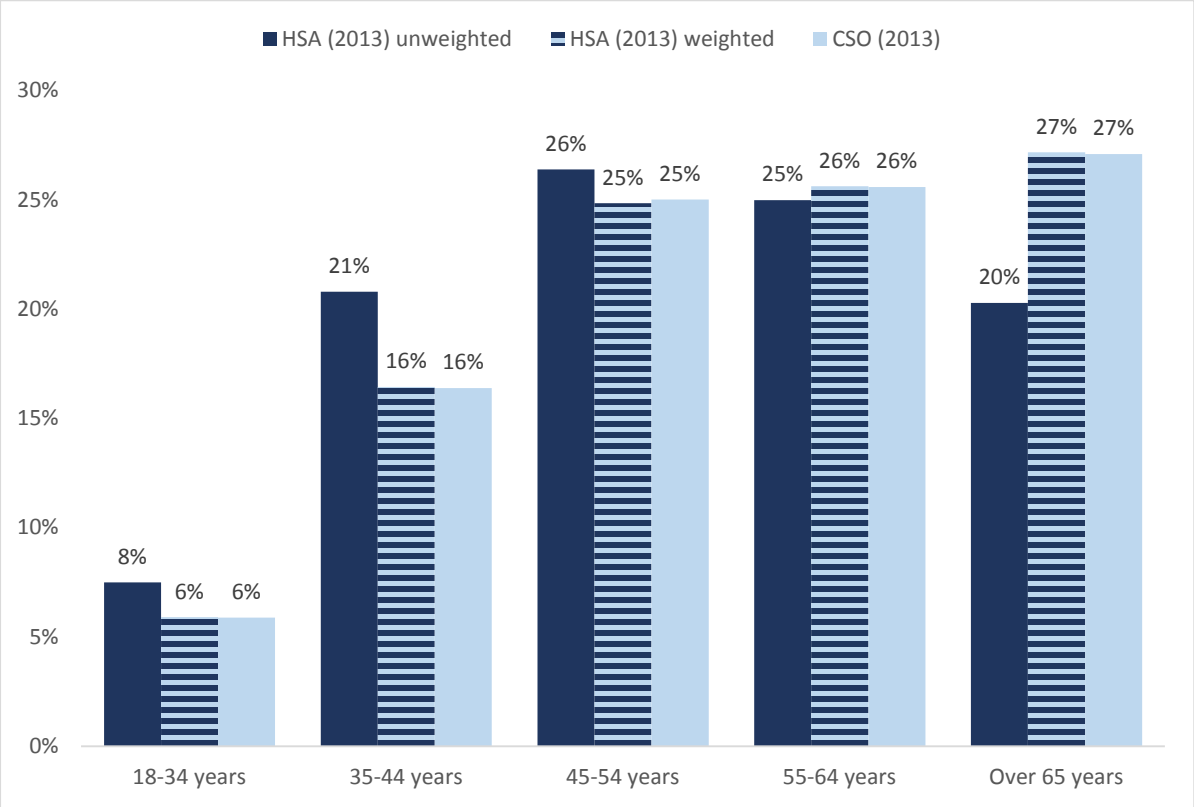
The re-calibration weights were constructed using the ReGenesees programme in R, developed at the Italian National Institute of Statistics.[19] This is an open-source programme for design-based and model-assisted analysis of complex sampling surveys, which incorporates a sub-routine for calibration of samples (Zardetto, 2014). The re-calibration provided weights to adjust the HSA survey sample to the population characteristics as measured by the CSO survey and census. The method constructed weights using the 'logit' distance function and constraining the range of the weights to be as narrow as possible. This was necessary in order to minimise the impact of the weights on the standard errors and, hence, confidence intervals based on the weighted sample data. The control totals were farm size (five categories), farmer age (five categories) and type (dairy specialist or other).

[18] See http://www.cso.ie/en/releasesandpublications/ep/p-fss/farmstructuresurvey2013/backgroundnotesappendices/.
[19] ReGenesees was developed as an open-source substitution for the SAS-based version of GENESEES, to calibrate sample observations and to calculate sampling variance. It has been used at ISTAT since 2007. ReGenesees is available at JOINUP — the European Commission open source software repository https://joinup.ec.europa.eu/software/regenesees/description. Further information can be found at: http://www1.unece.org/stat/platform/display/msis/ReGenesees.

The next three figures show how the unweighted and weighted HSA samples compared to the 2013 CSO survey in terms of these characteristics. As can be seen, the weighting calibrates the HSA sample to the CSO population structure in terms of farmer age, farm size and farm type (dairy or other).

In the HSA farm study, farmers were asked to indicate their age rather than provide their exact age. Figure 1.5 compares these categories to corresponding ones in the CSO survey.

FIGURE 1.5 COMPARISON BETWEEN SURVEYS OF FARMERS' AGE



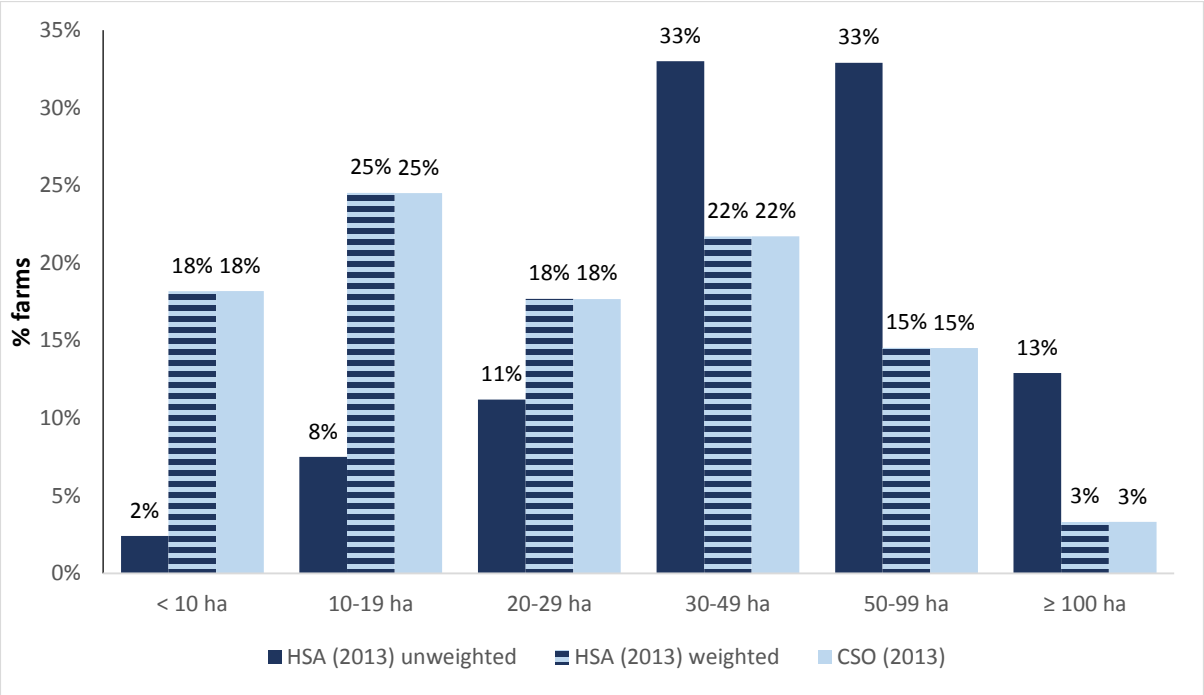
Source: CSO Farm Structure Survey 2013 Key Findings; Authors' own analysis of HSA Farm Safety Research Datafile.

In both the unweighted HSA and CSO samples, a minority of farmers were aged under 35 years (eight per cent of HSA respondents and six per cent of those from the CSO survey). However, there are more farmers aged over 65 years in the CSO survey (27 per cent) compared to the unweighted HSA survey (20 per cent) and slightly less in the 35–44 years age bracket: 16 per cent compared to 21 percent.

Figure 1.6 below shows that the size of land farmed differs between the HSA and CSO sample. At an average of 61 hectares, the average farm size in the HSA farm study is almost twice the figure found in the CSO sample (32.5 ha in 2013). It appears that the farmers who completed and returned the postal survey and those who agreed to be interviewed at the marts were farmers of larger sized

farms; this suggests that the unweighted HSA sample may underrepresent farmers of smaller sized farms. The weighting adjusts the distribution by farm size in the HSA sample to the CSO figures.

FIGURE 1.6 COMPARISON BETWEEN SURVEYS OF FARM SIZE



Source: CSO Farm Structure Survey 2013 Key Findings; Authors' own analysis of HSA Farm Safety Research Datafile.

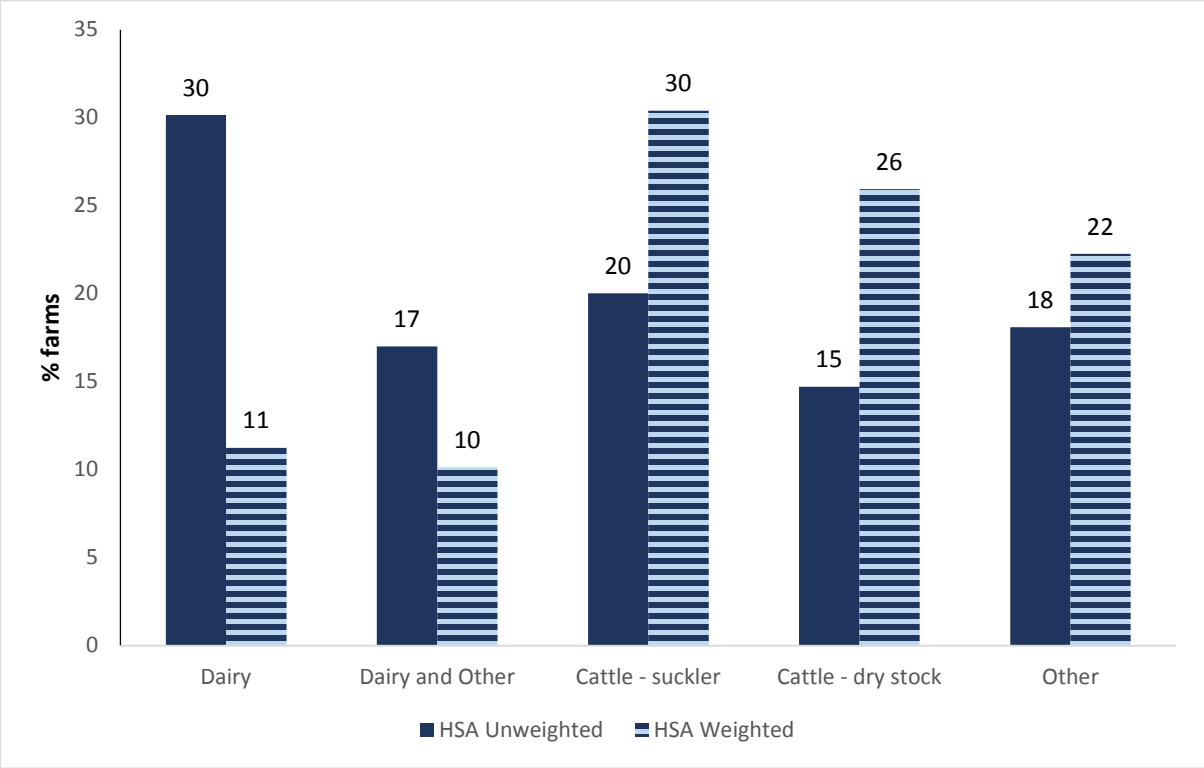
There were also differences between the CSO data and the HSA farm survey in terms of farm type. Analysis shows that 'dairy' farming is the most prevalent farm type in the HSA farm survey (30 per cent of farms). This is followed by 'suckler cattle' (20 per cent), 'dairy and other farming' (17 per cent), and 'dry stock cattle' (15 per cent). This is significant in light of the findings relating to safety on farms with animals and in particular on dairy farms.

As the categories used to group farm types differs in the CSO samples, direct comparisons are difficult, though it is worth noting that in the Farm Structure Survey (2013) only 11 per cent of farms are 'dairy' farms. The weights adjust the proportion of dairy farms to 11 per cent in the HSA sample in line with the CSO figures. The resulting distribution of farm types in the unweighted and weighted HSA sample are shown in Figure 1.7.

The weighted figures show just over one-fifth of farms involve dairying, with 11 per cent being dairy specialists. Over half are involved in raising cattle (30 per

cent suckler cattle and 26 per cent dry stock) with the remainder (22 per cent) carrying out other types of farming, including tillage, sheep farming and mixed farming. There are too few cases in the sample of farmers who specialise in tillage and sheep to show separately.

FIGURE 1.7 FARM TYPE IN THE UNWEIGHTED AND WEIGHTED HSA SURVEY DATA



Source: Authors' own analysis of HSA Farm Safety Research Datafile.

1.5.3 Analysing the weighted survey data

The data are analysed using statistical methods appropriate for analysing survey data. Specifically, given that the data are weighted, the standard errors, confidence intervals and statistical tests need to be adjusted to allow for the increased variability of estimators. This is done using the 'svy' routine in Stata (StataCorp, 2013a and 2013b; Thompson, 2012; and Williams, 1978). All of the results reported are based on weighted data.

Because of the small number of cases in certain categories, such as young farmers and small farms, we can be less confident in generalising the results based on these cases than on those based on the larger groups. We report confidence intervals and the results of significance tests to guide the reader in this respect and note in the text where results cannot be generalised from the sample to the population of all farms.

In chapters 3 and 4, where we examine factors associated with risk taking and with accidents, we use statistical models to help identify the most salient factors. The statistical models were logit models, run in Stata, again using the 'svy' routine. The results are presented as odds ratios and the interpretation is described as the results are presented.

1.6 OUTLINE OF REPORT

In this chapter, we discussed the literature on farm safety, which noted the very high rate of fatalities in the agriculture sector relative to the numbers working there. It also pointed to a number of factors associated with a heightened risk of farm accidents, including use of heavy machinery, working with large livestock, farm size (with higher risk found in the smallest and largest farms), the dairy sector, farmer age (with the youngest and oldest farmers at high risk), inexperience, working long hours and not implementing safety measures. We then described the HSA Farm Safety Study, conducted in 2013, and the reweighting procedure we used to ensure that these data are representative of all farms in terms of farmer age, farm size and type (whether dairy or not).

In the next chapter, we present descriptive results from the HSA survey, using the weighted data, including characteristics of the farmer and farm, risk taking, farmer distress, work-related stress and the experience of accidents or near misses.

In Chapter 3 we examine the factors associated with risk taking, based on a statistical model designed to disentangle the effects of related characteristics such as farm size and farm type.

In Chapter 4 we explore the association between farmer and farm characteristics and risk taking and the experience of farm accidents or near misses. Finally, in Chapter 5 we draw together the results of the study to answer the research questions and discuss the policy implications of the findings.

CHAPTER 2

Characteristics of the farmer and the farm

2.1 INTRODUCTION

In this chapter, we present an overview of the characteristics of the farmers and farms in the HSA survey, with the data calibrated so that they represent the Irish population of farms in terms of farmer age, farm size and farm type (whether dairy or not). We then discuss the measurement of risky behaviour, work-related stress and distress as well as the indicators of farm accidents or 'near misses'. These indicators form the basis of the multivariate analyses in later chapters. This allows us to examine differences in, for example, safe working practices and the prevalence of accidents by farm and farmer characteristics.

2.2 CHARACTERISTICS OF HSA FARM STUDY OF FARMERS AND FARMS

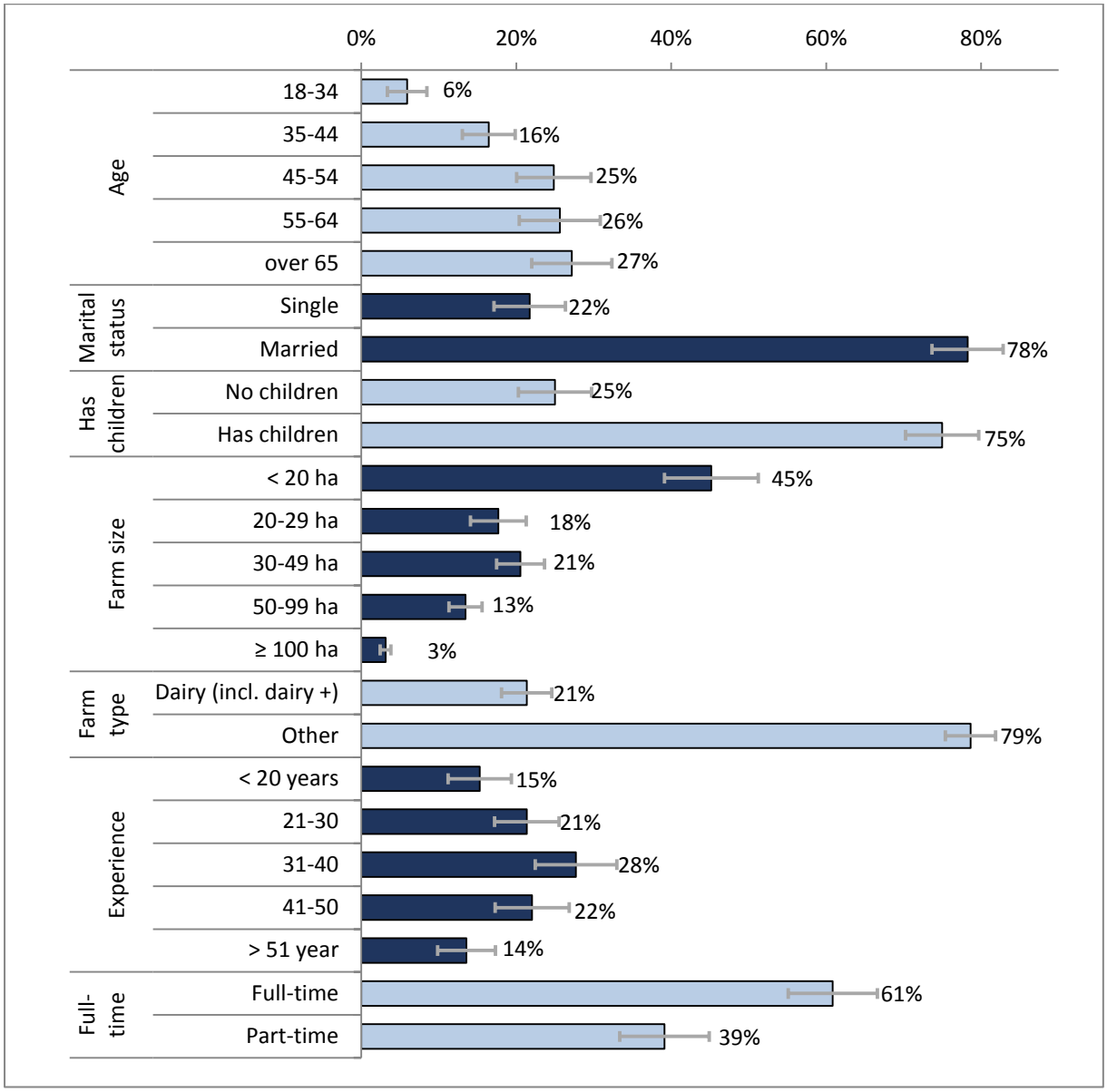
Figure 2.1 summarises the characteristics of the farmers and of the farms, weighted to represent the population. The figure also shows the error bars representing the 95 per cent confidence interval around the estimate. The confidence interval is the range within which we can say with 95 per cent confidence the population proportion lies. This will depend on how close the sample percentage is to 50 per cent (the interval gets wider closer to this rate) and on the sample size. For instance, the interval around the estimate of the percentage of farms less than 20 hectares is wider than the interval around the estimate for farms 50 to 99 hectares. This is because the percentage is closer to 50 per cent for the smaller farms and, as we saw in Figure 1.5, the number of cases is also smaller.

As we saw in the previous chapter, farmers tend to be older, with only 22 per cent under 45 years and 27 per cent over the age of 65. They are likely to be married (78 per cent) and to have children (75 per cent). We do not know the ages of the children, however – given the age profile of farmers, the figure is likely to include adult children.

Having adjusted according to the CSO figures using weights, as described in the previous chapter, 45 per cent of farms are under 20 hectares, 39 per cent are between 20 and 50 hectares and just 18 per cent are over 50 hectares. We distinguish between farms that involve dairying and other farms since the literature suggests a higher accident rate on dairy farms. Just over one-fifth of farms involve some element of dairying (with 11 per cent being dairy specialists, as seen in the previous chapter). Because of their age profile, most farmers have

a good deal of experience in farming, with more than 85 per cent having at least 20 years' experience.

FIGURE 2.1 CHARACTERISTICS OF FARMERS AND FARMS



Source: Authors' analysis of HSA Farm Safety Survey data, weighted. The error bars show the bounds of the 95% confidence intervals.

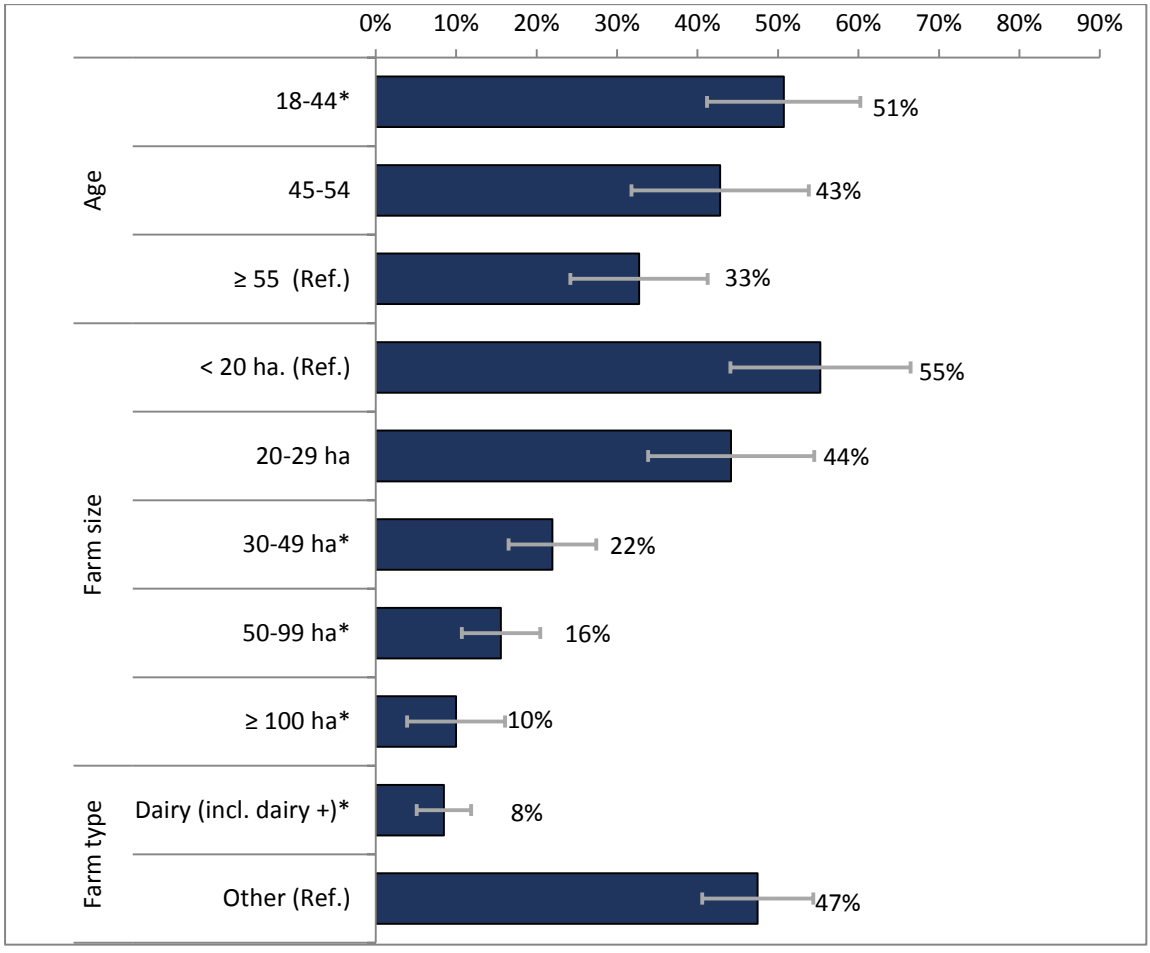
In terms of hours worked, the HSA farm survey asked the simple question: 'Do you work as a farmer full-time or part-time?' Most farmers in the HSA survey said they work full-time (61 per cent) but a sizeable minority work part-time (39 per cent). Those farming part-time may have had another job as well, though this was not measured in the survey.

The CSO farm structure surveys and agricultural censuses measure the significance of farm work. This is not directly comparable with data from the HSA

survey, but it confirms the significance of second jobs among farmers. The CSO surveys find that farming is the sole occupation for just over half of farmers (50.5 per cent in 2010 and 53.9 per cent in 2013; CSO, 2014, Table 4.3).

Figure 2.2 shows that part-time farming is more common on smaller farms, among younger farmers and outside the dairy sector. This is not surprising, as all else being equal, larger farms are likely to require more labour while it would not be feasible to manage the intensive demands of dairy farming on a part-time basis. The figure also shows whether these differences in the rate of part-time working are statistically significant. That is, based on the sample size and the magnitude of the differences we observe in the sample, can we say with 95 per cent confidence that these differences are also found in the population of all farms? The differences by age, farm size and sector (dairy or not) are statistically significant.

FIGURE 2.2 PART-TIME FARMING BY FARMER AGE, FARM SIZE AND TYPE



*Source: Authors' analysis of HSA Farm Safety Survey data, weighted. The error bars show the bounds of the 95 per cent confidence intervals for per cent part-time within each group. * indicates a significant difference in the per cent part-time compared to the reference category in each group.*

2.3 RISK TAKING

The survey measured farmers' behaviour in terms of safe working practices on the farm, using six items (see Table 2.1).[20] These items were reverse scored and scaled in order to get a score for farmers' level of *risky work behaviour*.[21] Response categories for individual items ranged as follows; five (never), four (rarely), three (sometimes), two (most of the time) and one (all of the time'). Therefore, higher scores indicate a higher level of risky work behaviour. A reliability analysis showed that the 'risky work behaviour scale' had an alpha level of .644, which indicates a reasonable level of reliability. A scale based on the average across the six items ranges from one (low risk taking) to five (high risk taking). The mean of 1.63 indicates that the average farmer tends to operate safely most of the time.

TABLE 2.1 RISKY WORK BEHAVIOUR SCALE (6 ITEMS) DESCRIPTIVE STATISTICS

Scale items	% never, rarely or sometimes*	Margin of error
1. I wear safety gear when necessary (goggles, ear defenders, high-vis etc.).	25.9%	±4.5%
2. I use restraining or handling facilities when treating animals.	8.4%	±3.3%
3. I check that tractors and machinery are in good working order before use (e.g. brakes, lights, PTOs etc.).	11.2%	±3.6%
4. I work with machinery without a PTO or proper guarding.*	11.9%	±3.7%
5. I keep chemicals safely stored away from access by children.	3.0%	±1.4%
6. I get help when I need to do difficult jobs.	26.8%	±5.0%
Scale statistics		
N valid (missing) = 828 (8); alpha = .644 (std.); scale mean (SE)= 1.63 (.03); 95% confidence intervals = 1.58–1.68; minimum = 0; maximum = 5.		

*Source: Authors' analysis of HSA Farm Safety Survey data, weighted. *Risk taking refers to 'never', 'rarely' or 'sometimes' except for item 4 where it refers to 'all of the time' or 'most of the time' or 'some of the time'.*

Table 2.1 also shows the percentage of farmers who never, rarely or only sometimes take each safety precaution: that is, they engage in the type of risk taking in question. The highest prevalence is for not getting help with difficult tasks and not using safety gear: 27 per cent of farmers do not routinely get help

[20] The original scale contained seven items; however, one item ('I feel anxious working around animals in close quarters') was removed as it did not correlate well with the other items and lowered the overall scale alpha level.
[21] The scale value was based on the average across the items on which responses were available.

and 26 per cent do not regularly use safety gear. Almost 12 per cent of farmers do not routinely use guarding for machinery (such as a power take-off system or PTO guard) and 11 per cent do not routinely check machinery before use. The percentages who report not routinely using animal restraints when treating animals is eight per cent, while just three per cent fail to keep chemicals away from possible access by children.

2.4 EXPERIENCE OF FARM ACCIDENTS OR NEAR MISSES

Three direct questions relating to the occurrence of farm accidents were asked in the survey. The questions asked were as follows.

1. 'Have you **personally** been involved in an accident on your farm in the last ten years?' (Yes/No).

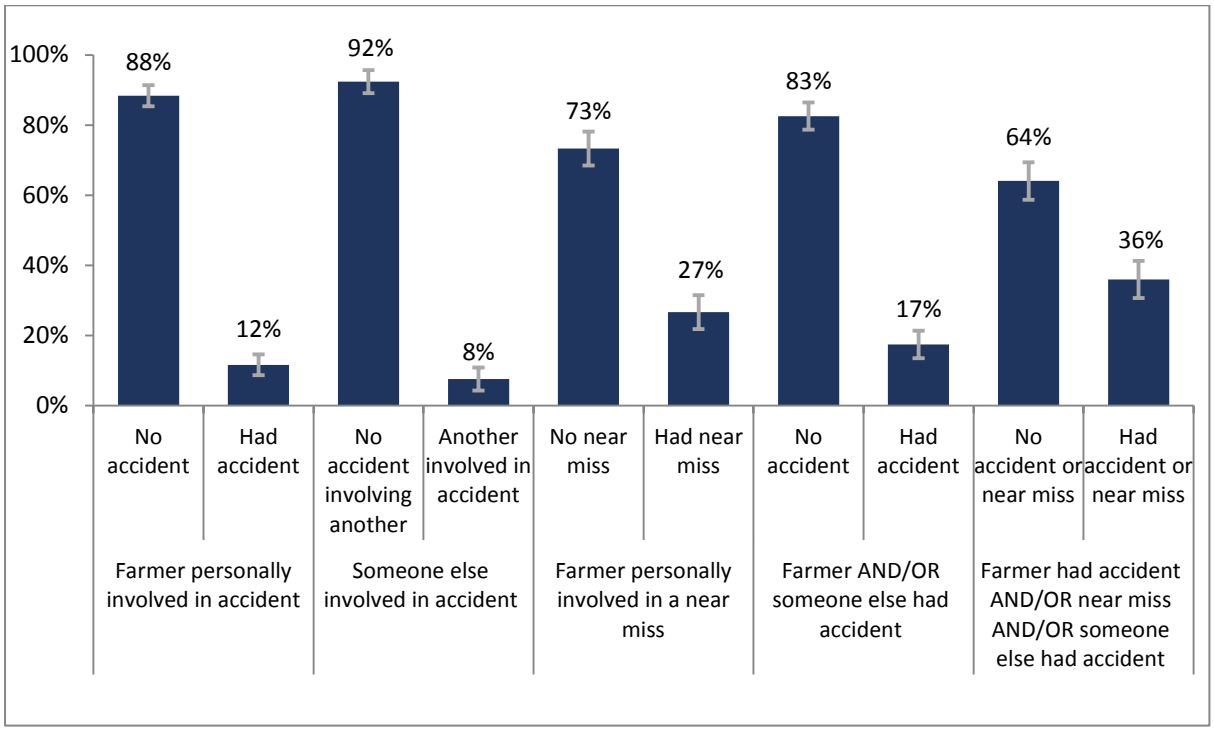
2. 'Has **anyone else** been involved in an accident on your farm (while you were the main farm holder/owner) in the last ten years?' (Yes/No).

3. 'A **'near miss'** could be described as a 'very lucky escape', in other words, a near miss is an event that occurred which may have resulted in an accident, but by pure luck did not. Have you personally been involved in a near miss on your farm in the last ten years?' (Yes/No).

Analysis of the responses to these questions reveals that nearly one in eight farmers (12 per cent) had personally experienced an accident on their farm in the preceding ten years. About eight per cent of farmers reported that someone else had had an accident on their farm and over one-quarter (27 per cent) had been involved in a near miss (see Figure 2.3).[22] When these responses were combined it was found that 17.5 per cent had either been personally involved in an accident and/or someone else had an accident on their farm, while over one-third of all farmers had experienced any type of incident: that is, they had personally had an accident and/or a near miss and/or someone else had had an accident on their farm.

[22] This analysis also used weighed data.

FIGURE 2.3 OCCURRENCE OF ACCIDENT OR NEAR MISS ON THE FARM OVER THE LAST TEN YEARS

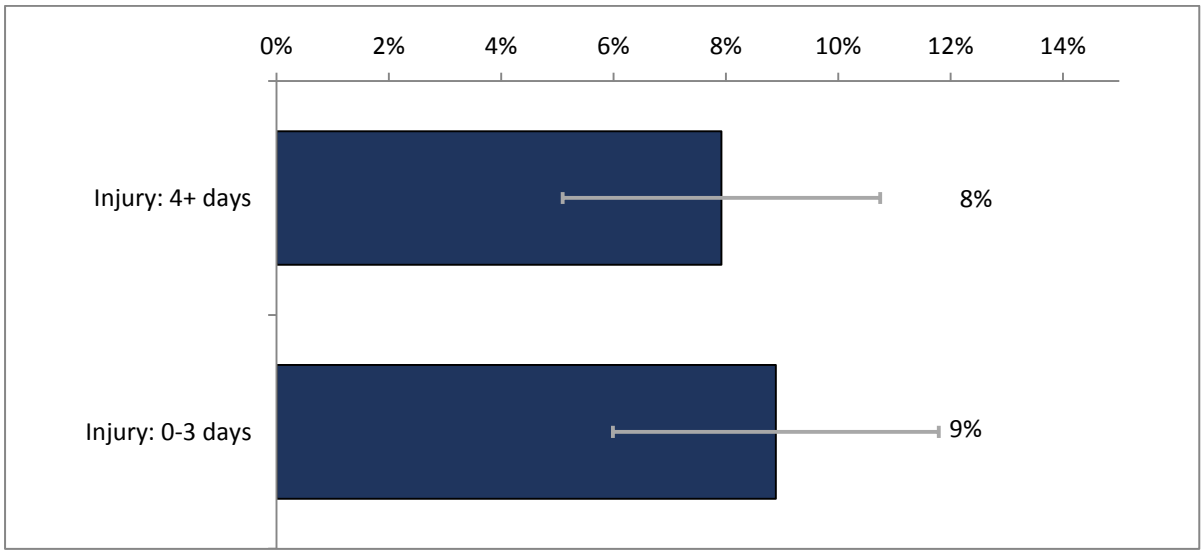


Source: Authors' analysis of HSA Farm Safety Survey data, weighted. The error bars show the bounds of the 95 per cent confidence intervals for each percentage.

The ten-year reference period for farm accidents is very long, and there are likely to be recall problems leading to an under-reporting of incidents that occurred farther in the past (Landen and Hendricks, 1995; Warner et al., 2005). However, an accident or near miss is a significant event, so we might expect the impact of any recall problems to mainly affect less serious incidents (Murphy, 1981; Napier et al., 1985).

Figure 2.4 shows the distribution of responses to the question on the severity of the accident, as measured by indicating the resulting number of days off work. The information is available only for accidents (not for near misses). On eight per cent of farms there had been an accident where someone was injured and had to spend four or more days off work. On nine per cent, an accident involved someone being injured and as a result spending no time off work or less than four days. By definition, a fatal accident can only have occurred to someone other than the farmer responding to the survey. A fatal accident occurred on less than one per cent of the farms and is not shown in the figure because of the small number of cases.

FIGURE 2.4 PERCENTAGE OF FARMERS REPORTING ACCIDENTS LEADING TO WORK ABSENCE OF 0–3 DAYS OR 4 OR MORE DAYS



Source: Authors' analysis of HSA Farm Safety Survey data, weighted. The error bars show the bounds of the 95 per cent confidence intervals for each percentage.

We might expect that the experience of an accident or near miss would result in a change in behaviour. Farmers who had experienced an accident (to themselves or someone else) were asked whether they had changed their behaviour as a result. Roughly one half reported changing something on the farm because of the most serious accident (51 per cent but with a relatively wide margin of error of plus or minus 12 per cent). An open-ended question recorded what had changed. Responses included specific changes like buying new machinery or replacing gates but also becoming more aware and careful. The fact that behaviour is likely to have changed in response to an accident, and perhaps also in response to a near miss, means that the observed association between the experience of accidents and risk taking will be weaker than if we had a measure of behaviour at the time of the accident.[23]

2.5 FARMER DISTRESS

Some of the literature discussed in Chapter 1 suggested a link between depression and not taking safety precautions (Beseler and Stallones, 2010). It is worth examining whether there is an association between mental distress and the characteristics of farmers and farms, as it may throw some light on findings reported later in this report.

[23] There was no association between having changed something following an accident and the level of current (at the time of interview) risk taking on any of the six types of risk for the subset of farmers who had experienced an accident. This is not conclusive since those who had changed something following an accident may have been the farmers who were more likely to take risks beforehand and we do not have information on prior levels of risk taking.

The HSA survey measured farmers' level of mental and emotional well-being using the World Health Organization's five-item Well-Being Measure (WHO-5). This is a valid, reliable and internationally recognised instrument. This scale consists of items that assess how respondents had been feeling in relation to each statement (see Table 2.2) in the previous two weeks. Responses ranged from 0 (at no time) to 5 (all of the time). Scores on these items were reversed, with higher scores indicating higher levels of distress. A reliability analysis showed that the 'distress scale' had an alpha level of 0.866, indicating a high level of reliability. The mean was 1.55, indicating a generally positive frame of mind, with low levels of distress.

TABLE 2.2 DISTRESS SCALE (5 ITEMS) DESCRIPTIVE STATISTICS

Scale items
1. My daily life has been filled with things that interest me.
2. I have felt cheerful and in good spirits.
3. I have felt calm and relaxed.
4. I have felt active and vigorous.
5. I woke up feeling fresh and rested.
Scale statistics
N Valid (missing) = 755 (61*); alpha = .866 (std.); scale mean (SE)= 1.55 (.63); variance = .85; minimum = 0; maximum = 5.

*Source: Authors' analysis of HSA Farm Safety Survey data, weighted. * The figure for missing cases is higher here as the items on well-being were not asked in the face-to-face interviews at the farmers' marts (n = 49).*

We examined whether levels of farmer distress differed by characteristics of the farmer or farm. There were no significant differences in means scores for distress by any of the farmer or farm characteristics. This means distress scores did not vary depending on farmers' age, marital status, whether or not they had children, their work status, number of years farming, or type or size of farm. We got similar results when we used an alternative specification of the distress scale where we focused on the rate of high levels of distress (being in the most distressed ten per cent). Again, there was no significant association with famer or farm characteristics. It may be, as the literature suggests (Roberts and Sul Lee, 1993; Wallis, 2008), that farmers are more likely than other occupational groups to experience low levels of well-being and distress, but our results do not indicate large differences in this respect by farmer and farm characteristics.

2.6 STRESS RELATED TO FARM WORK

Work stress has been identified as a factor in some research studies on farm safety, with Furey et al. (2016) noting a link between farm stress and

expectations of injury among Irish dairy farmers. It is worth asking whether there are differences in work stress by farmer and farm characteristics.

The HSA survey presented respondents with ten 'concerns' that could be considered farm-related stressors. We focused on four items of 'work–related stress'.[24] The descriptive statistics for the 'work-related stress scale' are shown in Table 3.4 below. The response categories for individual items ranged as follows; one (not at all concerned), two (a little concerned), three (concerned), four (quite concerned) and five (very concerned). Therefore, when items were scaled, the scores ranged from one to five, with higher scores indicating higher levels of stress. A reliability analysis found this scale to have an acceptable alpha level of .727.

TABLE 2.3 WORK-RELATED STRESS SCALE (4 ITEMS) DESCRIPTIVE STATISTICS

Scale items
1. Government regulations and policies
2. Farm paperwork
3. Financial matters
4. Workload
Scale statistics
N valid (missing) = 827 (9); alpha = .727 (std.); mean (SE) = 3.33 (.05); variance = .89; minimum = 1; maximum = 5.

Source: Authors' analysis of HSA Farm Safety Survey data, weighted.

The mean score on the scale was 3.33, indicating a medium level of work-related stress. Contrary to expectations, work-related stress tended not to vary by farmer or farm characteristics. There were no major differences in work-related stress levels as measured here by broad age group, marital status, presence of children, part-time working, or type or size of farm. The only significant difference was that farms between 20 and 30 hectares were associated with a lower level of reported stress (about 0.3 on the five-point scale) than farms under 20 hectares.

[24] Principle components analysis initially resulted in three dimensions but with items grouping in an indistinct pattern. As almost 72 per cent of the sample farmers are over 45 years, the factor analysis was repeated with the sample grouped into those aged over 45 years and those under 45 years. The distribution of responses from the older age group mirrored that of the general sample; however, two distinct components of 'work stress' and 'psychological stress' were revealed among the younger farmers. As there are five items in the survey that directly measure psychological well-being (see previous section) it was deemed appropriate to retain the four 'work stress' items as a measure solely of work related stress.

2.7 SUMMARY

In this chapter, we have provided descriptive information on the farmers and farms in the HSA survey and discussed the measurement of risk taking and farm accidents. We saw that, when calibrated to the population of farms, most farmers are over 45 years (78 per cent), married (also 78 per cent) and have children (75 per cent). Because of their age profile, they are generally very experienced, with 85 per cent having 20 or more years' experience of farm work. Farms under 30 hectares account for 63 per cent of the total and just 16 per cent are over 50 hectares. About one-fifth of farmers are involved in dairying, with half that number being dairy specialists. A considerable minority of farmers work part-time (39 per cent) and part-time farming was more common among young farmers (51 per cent of the 18–44 age group), on small farms (55 per cent of farms under 20 hectares) and in farms other than dairy farms (47 per cent).

The indicator of risk taking is based on non-use of six safety procedures: using safety gear, using animal restraints, checking machinery before use, using guards or PTO devices on machinery, safely storing chemicals and getting help for difficult jobs. Of these, the most common forms of risk taking were not routinely getting help and not routinely using safety gear (27 per cent and 26 per cent).

The experience of farm accidents over the previous ten years was measured. On about 12 per cent of farms, the farmer had experienced an accident, on eight per cent of farms someone else had been in an accident and on 27 per cent the farmer had been involved in a 'near miss'. At least one of these three types of incident had occurred on over one-third of farms in the previous ten years.

Since some previous research suggested that mental distress and work stress might be related to reduced safety, we examined whether these varied by characteristics of the farmers or farms. In general, they did not, with only small differences found by farm size for work-related stress.

The next chapter focuses on variations in risk taking on farms.

CHAPTER THREE

Predictors of risk taking

3.1 INTRODUCTION

In this chapter, we focus on the factors associated with risk taking by discussing the results of a number of multivariate statistical models. These models allow us to isolate the impact of related factors, such as farm size and farm type, and identify those that may be most significant in accounting for differences in risk taking. We first examine high levels of risk taking in general, considering all six different types of risk. We then examine each type of risky behaviour separately.

For technical reasons, factors that are highly associated with each other cannot both be included in these models. For instance, marital status and having children are highly associated; as some preliminary analysis suggested that having children was less strongly associated with risk taking, this was dropped and marital status was retained. Similarly, years of experience is very closely associated with farmer age and farmer age seemed to have the stronger association with risk taking, so the latter (farmer age) was retained in the models.

3.2 OVERALL RISK TAKING SCALE

The risk taking scale assigned higher scores to farmers who were less likely to take certain safety precautions. These precautions were measured using the following six items: the wearing of safety gear; use of restraining facilities to treat animals; checking tractors and machinery for good working order; using a PTO or proper guard with machinery; safe storage of chemicals; and getting help with difficult jobs.

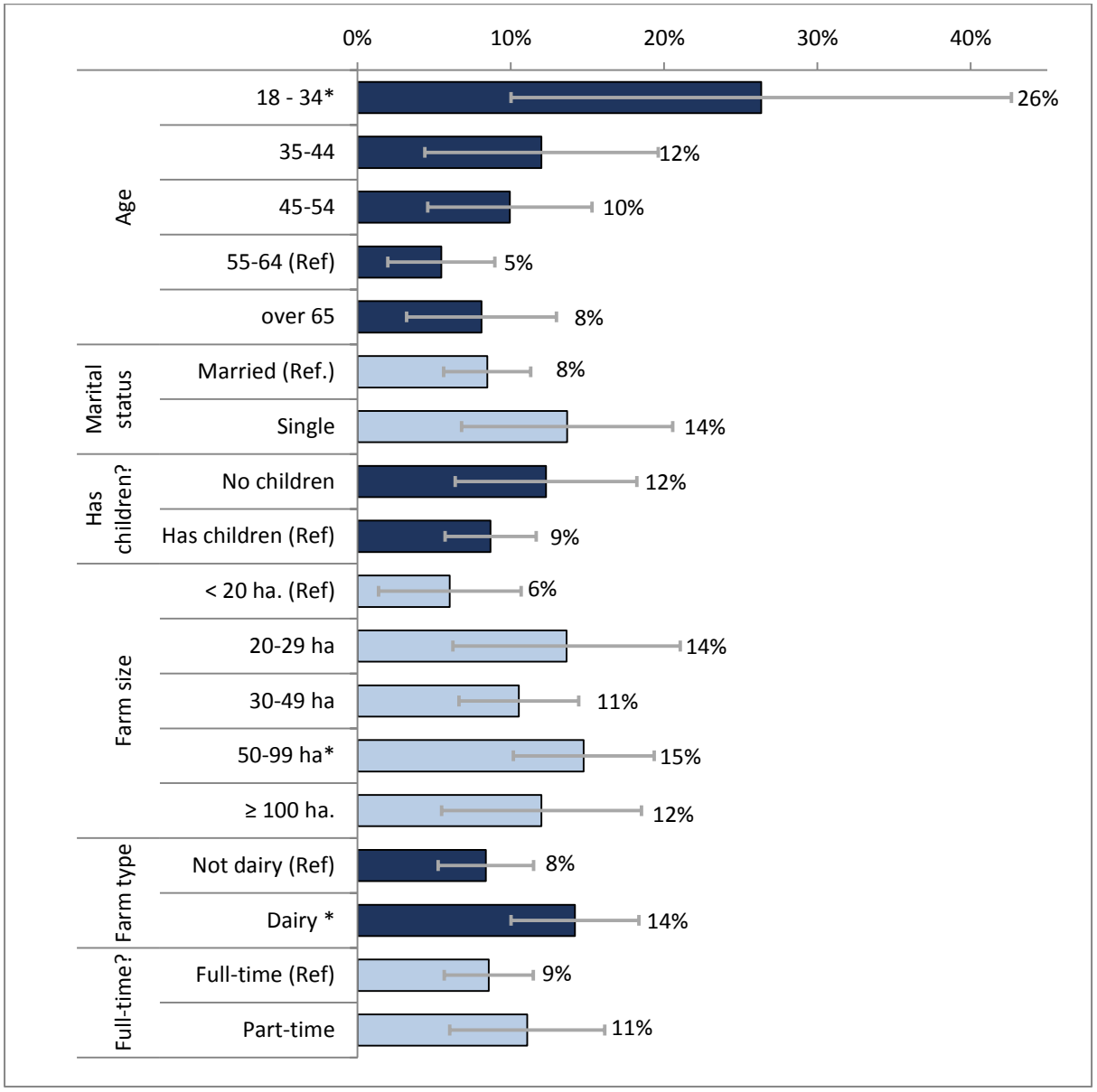
3.2.1 Descriptive results on risk taking

We examine the rate of high risk taking; that is, of being in the top ten per cent on the risky behaviour scale. This allows us to compare the features of those farmers who scored highest on the unsafe work behaviour scale with all other farmers. We did this because we would expect to see the impact of risk taking most clearly in the contrast between the highest risk-takers and the majority of farmers who rarely or never take risks. Results, using weighted data, are shown below in Figure 3.1.

These results suggest a tendency for younger farmers to be in the highest risk taking decile, with a significant difference between the 18–34 years group (26 per

cent) and the 55-64 years group (five per cent). The rate for farmers aged 65 years and over does not differ significantly from that for those aged 55–64 years.

FIGURE 3.1 FARMERS IN TOP DECILE ON RISK TAKING SCALE BY FARMER AND FARM CHARACTERISTICS



*Note: *Significant differences at p<=.05 compared to the reference category. Error bars show the upper and lower bounds of the 95 per cent confidence interval around each percentage. Note that two proportions may be significantly different, even if the confidence intervals for both proportions overlap slightly. See* https://www.cscu.cornell.edu/news/statnews/stnews73.pdf *for an explanation.*

Size of land farmed and type of farm also appear to affect farmers' risk taking behaviour. Significantly more farmers whose holdings are between 50 and 99 hectares (15 per cent) are found in the top decile when compared to those with

less than 20 hectares of land (six per cent). The six percentage point difference between dairy and non-dairy farmers is also statistically significant.[25]

While there is a general pattern in the sample of more risk taking among farmers who are single, who have no children and who work part-time, these differences are not statistically significant. In other words, the weak patterns we find in the sample are not strong enough, given the sample size and structure, for us to be confident that the differences are also found the general population of farmers.

Box 1: Statistical models

We use statistical models to help identify the most salient factors associated with risk taking (in Chapter 3) and the experience of accidents and near misses (Chapter 4). The statistical models were logit models, estimated using statistical methods appropriate for analysing complex weighted survey data (the 'svy' routine in Stata; see StataCorp, 2013a and 2013b; Thompson, 2012; and Williams, 1978).

Logit models are appropriate when the dependent variable is binary, such as taking risks or experiencing an accident.

The results are presented as odds ratios and the interpretation is as follows. Let's say the dependent variable is risk taking and we are examining the odds ratios for each age group compared to those aged 55 years or older (the reference category). An odds ratio of 1 for those under age 30, for instance, would indicate that this age group does not differ at all in terms of risk taking from those aged 55 and over. An odds ratio greater than 1 (for instance, 2) would indicate that those under 30 are more likely to take risks (twice the odds of risk taking). An odds ratio less than 1 (for instance 0.25) would indicate that those under 30 years are less likely to take risks (0.25 would indicate the odds are only one-quarter as high for those under 30 as for the reference age group).

3.2.2 Model results on risk taking

The previous section focused on the relationship between risk taking and individual farmer and farm characteristics. We know from Chapter 2, however, that associations exist between some of these farmer and farm characteristics. For example, young farmers are more likely to work part-time. In this section, we report the results of a statistical analysis designed to identify the most salient factors. For instance, when we account for the fact that young farmers are more likely to work part-time, do we still see differences in the incidence of risk taking

[25] Note that two proportions may be significantly different even if the confidence intervals for both proportions overlap slightly. See https://www.cscu.cornell.edu/news/statnews/stnews73.pdf for an explanation.

by age? Technical details on the model are shown in Box 1 (above) and the results are summarised in Table 3.1.

Table 3.1 shows the results from a statistical model that predicts the likelihood of a farmer being in this top ten per cent of risk-takers depending on certain farmer and farm characteristics. These results are reported in the form of odds ratios, which compare the odds of a particular outcome occurring among one group against those of a reference group. Where values for the odds ratio are greater than one we can say that this group are more likely than the reference group to experience the outcome being tested. However, it should be noted that some of the patterns observed in this sample are not statistically significant. That is, we cannot say with 95 per cent confidence that the differences we find in the sample are also apparent in the general population of farmers. This may be because of the small sample size in some groups (see Figure 2.1), or the small differences observed in the sample, or some combination of the two. In the discussion, we emphasise those differences that are statistically significant, as indicated by the asterisks (*) in the table.

TABLE 3.1 FACTORS ASSOCIATED WITH RISK TAKING (ODDS RATIOS)

		Model 1 (Age, marital status)	Model 2 (Add farm size, hours)	Model 3 (Add dairy)	Model 4 (Trimmed)
Age	18–44 vs. 55+	2.47**	1.76	1.64	1.98*
	45–54 vs. 55+	1.44	1.3	1.21	1.27
Marital status	Single vs. married	1.57	1.68	1.75	1.70
Farm size (hectares)	21–30 ha vs. <20		2.36	2.29	
	31–50 ha vs. <20		1.99	1.74	
	51–100 ha vs. <20		2.88*	2.26	
	100+ ha vs. <20		2.34	1.95	
Full-time	Part-time vs. full-time		1.62	1.83	1.57
Farm type	Dairy vs. other			1.65	2.03**
Constant		0.07***	0.04***	0.03***	0.05***
N cases		823	823	823	823

*Note: Weighted results with robust standard errors (Stata svy). Dependent variable is risk taking based on being in the top ten per cent on scale based on five items. *** p<0.01, ** p<0.05, * p<0.10*

The results from the first model, when only farmers' age and marital status are included, suggest that younger farmers are about 2.5 times more likely to take risks (Model 1 in Table 3.1). There is no difference in overall risk taking by whether a farmer is single or married. In a separate piece of analysis, we also

tested whether farmers with children differed significantly from those without children but the results were not statistically significant.

In Model 2, which controls for farm size and whether the farmer works full-time or part-time, the age difference becomes non-significant. There is some tendency for risk taking to be more common on larger farms but the statistical significance of this pattern is only borderline ($p<0.10$) and is only found for one of the size categories (51–100 hectares compared to under 20 hectares). The pattern is no longer statistically significant in Model 3, where we add a control for being a dairy farmer.

When we include farm type, we see that dairy farms tend to be associated with higher odds of risky behaviour but this is not statistically significant. However, in the final model, which is trimmed to exclude farm size, we see that the influence of dairy farms is significant, increasing the odds of being in the high-risk group by about twice those of non-dairy farms. In addition, age becomes significant once more, though only marginally so. There is no significant difference for marital status or hours worked (or for having children, which was tested but is not shown here).

3.3 TYPES OF RISK TAKING

The model above examined the relationship between farmer and farm characteristics and the odds of being in the group with the highest total scores for the overall risk taking scale across all six items. We now explore how the same characteristics affect the odds of taking risks on each of the individual items. In other words, we are concerned with identifying what types of risky behaviour might be associated with certain features of the farmer and the farm. This is done by identifying those farmers who said that they adhered to safety measures never, rarely or only sometimes. The individual items or types of risky behaviour examined are: not wearing safety gear; non-use of animal restraint; not checking tractors and machinery; not using a PTO or machinery guard; unsafe storage of chemicals; and not getting help with difficult jobs.

3.3.1 Model results for types of risk taking

The results from a statistical model that explores how different types of risk taking vary according to certain farm and farmer characteristics are shown in Table 3.2.

For several of the types of risk, middle-aged farmers (45–54 years) tend to be less likely to take risks when compared to younger and older farmers, although this is only of borderline significance ($p<0.1$). These age differences are seen in the

following types of risky behaviour: non-use of safety gear; not using animal restraint; and improper storage of chemicals. The pattern is different for non-use of a PTO guard, where middle-aged farmers tend to be *more* likely to take risks, although, again, the significance level is just borderline.

While there were no significant differences in the model for overall high-risk scores depending on marital status, we find that single farmers are about twice as likely to fail to check that machinery is in good working order. We also tested whether having children was associated with a greater likelihood of taking risks, but there was no significant relationship.

Farmers from larger farms tend to be between two and three times more likely to not use safety gear. By contrast, those with the largest farms (>100 hectares) are less likely to fail to get help for difficult tasks (about one-third as likely). There are no statistically significant differences between other types of risk depending on farm size.

TABLE 3.2 FACTORS ASSOCIATED WITH TYPES OF RISK TAKING (ODDS RATIOS)

		Non-use of safety gear	Non-use of animal restraint	Not checking machinery	Non-use of PTO guard	Improper storage of chemicals	Not getting help
Age	18–44 vs. 55+	1.15	0.95	1.83	1.74	0.90	1.46
	45–54 vs. 55+	0.59*	0.44*	1.01	2.12*	0.33*	0.99
Marital status	Single vs. married	1.37	1.18	2.29**	1.10	0.59	1.58
Farm size (hectares)	21–30 ha vs. < 20	1.62	0.45	1.18	0.94	5.58	0.77
	31–50 ha vs. < 20	1.99**	0.88	0.8	1.22	1.02	0.78
	51–100 ha vs. < 20	2.71***	0.43	0.96	1.31	3.42	1.1
	100+ ha vs. < 20	2.94***	0.73	1.10	1.14	1.8	0.37**
Hours	Part- vs. full-time	1.33	0.63	1.75	1.36	3.97***	0.95
Farm type	Dairy vs. other	0.75	0.81	1.76	0.67	6.71***	0.99
Constant		0.22***	0.17***	0.06***	0.08***	0.01***	0.34***
N cases		823	823	823	823	823	823

*Note: Weighted results with robust standard errors (STATA svy) from logit model. The dependent variable is not taking each of the six safety precautions (i.e. taking safety precautions never, rarely or sometimes). *** p<0.01, ** p<0.05, * p<0.10.*

The only significant association for farmers working part-time is a greater likelihood of not storing chemicals safely. Dairy farms are also found to be less

likely to safely store chemicals; in this instance, the odds are nearly seven times those for non-dairy farms.

3.4 WORK-RELATED STRESS AND WORKER DISTRESS

Following from the literature reviewed in Chapter 1, we checked whether work-related stress or farmer distress were associated with the tendency to take risks. With the other characteristics in the model controlled (as shown in Tables 3.1 and 3.2), neither of these factors was significantly related to risk taking as measured by the summary six-term scale. In the case of work stress, there was no association with any of the six individual types of risk. However, two types of risk increased where the farmer had high levels of distress, as shown in Table 3.3.

Where the farmer was distressed, the odds of improperly storing chemicals were five times higher and the odds of not getting help with difficult tasks were nearly three times higher. That said, we need to be cautious in drawing conclusions from this pattern. It could be that farmers who experience distress are less careful about storing chemicals and are less able to get help. On the other hand, the causation might work in the opposite direction, at least in the case of getting help: it could be the case that not having someone to call on for help is a marker of social isolation, which can lead to distress.

TABLE 3.3 FACTORS ASSOCIATED WITH TYPES OF RISK TAKING: MODELS INCLUDING DISTRESS (ODDS RATIOS)

		Improper storage of chemicals	Not getting help
Age	18–44 vs. 55+	0.72	1.24
	45–54 vs. 55+	0.31**	0.95
Marital status	Single vs. married	0.52	1.54
Farm size (hectares)	21–30 ha vs. < 20	5.44	0.82
	31–50 ha vs. < 20	1.10	0.89
	51–100 ha vs. < 20	4.01	1.36
	100+ ha vs. < 20	2.11	0.44*
Hours worked	Part- vs. Full-time	3.74**	1.20
Farm type	Dairy vs. other	5.97***	1.02
Distress	High vs. not high	5.55**	2.91***
Constant		0.00***	0.28***
N cases		823	823

*Notes: Weighted results with robust standard errors (Stata svy) from logit model. The dependent variable is not taking each of the two safety precautions shown in the table. A control was also included in the model for the 55 cases missing on the measure of distress. *** p<0.01, ** p<0.05, * p<0.10.*

3.5 SUMMARY

A simple descriptive outline of the sample suggested that proportionately more of younger farmers, dairy farmers and, to some degree, those with larger sized farms tended to be in the top decile for unsafe work behaviour.

Results from multivariate models, which can help explain how certain factors might influence an outcome while controlling for related factors, supported this pattern. The model showed that when a range of farmer characteristics were held constant, younger farmers and dairy farmers were about twice as likely to engage in unsafe practices. While farm size appeared to contribute some influence, this was no longer a significant factor once dairy farming was accounted for.

We then examined how farm and farmer characteristics might affect different types of unsafe work practices. Again, age was significant (although only marginally), indicating that middle-aged farmers tended to take fewer risks compared to younger and older farmers on a number of risk types. These farmers were less likely to say that they did not use safety gear, did not use animal restraining methods and did not store chemicals correctly. They were *more* likely, however, not to use a PTO guard. Single farmers were more than twice as likely to fail to check that machinery was working properly. Farmers from larger farms were between two and three times more likely to not use safety gear. Those with the largest farms were less likely to not get help for difficult tasks. Dairy farmers and those working part-time were more likely to improperly store chemicals.

Work-related stress was measured in terms of concern about workload, paperwork, government regulation and bad weather. This was not related to risk taking, however. Distress, as measured by five questions on how the farmer had been feeling lately, was related to two types of risk. Where the farmer had high levels of distress, the odds of improperly storing chemicals were five times higher and the odds of not getting help with difficult tasks were nearly three times higher. However, the overall rate of improperly storing chemicals (i.e. storing them where children may reach them) is very low. We caution that these associations do not necessarily imply causation. Farmers experiencing distress may be less likely to seek help with difficult tasks, or it might be that both the experience of distress and difficulty getting help may be related to another underlying factor, such as social isolation.

CHAPTER 4

Factors associated with farm accidents

4.1 INTRODUCTION

In this chapter, we turn to the occurrence of accidents on farms and use multivariate modelling to examine how the number of incidents and different types of farm accidents might vary according to the same farmer and farm characteristics used in the previous chapter. We include risk taking in these models as an additional characteristic in order to assess any influence this might have on farm accidents. Risk taking is added in both forms described in Chapter 3. This means that both the top-scoring decile and those who scored highest on each of the six individual indicators are examined. As mentioned, marital status and having children are highly interrelated; in this instance, initial analysis indicated a slightly stronger association between having children and accident occurrence so this was indicator was retained and marital status dropped.

We begin by presenting descriptive results showing the relationship between accidents and farmer and farm characteristics. We then present the results of some statistical models designed to isolate the most important factors causing variations in accident levels. Two sets of models are presented. The first looks at the characteristics associated with the occurrence of any type of farm accident or near miss. A second set of models examines the different types of incident separately: whether the farmer was personally involved in an accident, whether someone else was involved in an accident on the farm and whether the farmer was involved in a near miss.

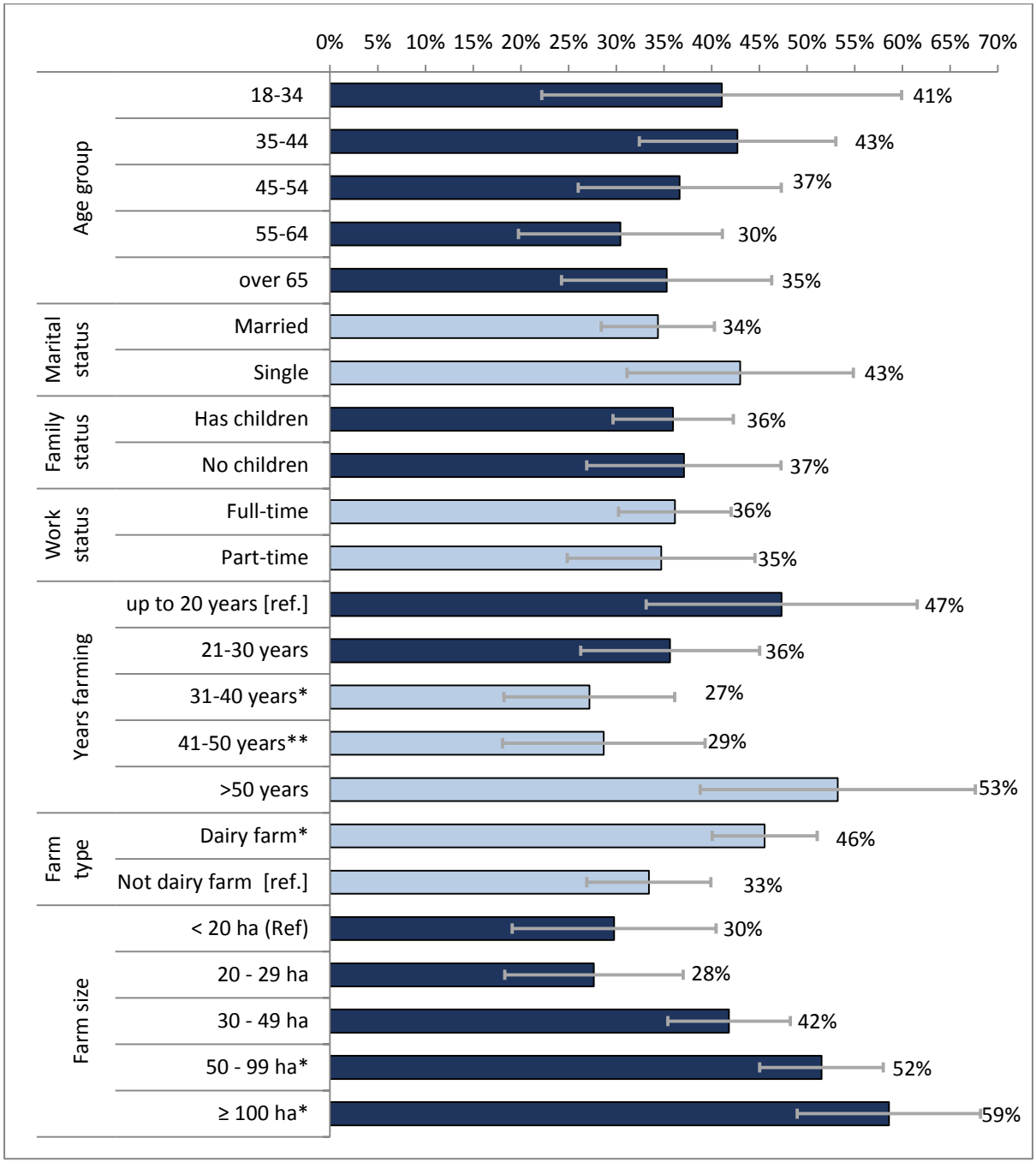
4.1.1 Descriptive relationship between farming accidents or near misses and farmer or farm demographics

Figure 4.1 shows how different farmer and farm characteristics may affect the occurrence of 'any type of accident' (i.e. farmer personally had an accident and/or a near miss and/or someone else had an accident on their farm). As with risk taking, there appears to be an association between accident occurrence and younger farmers in the sample, although this time the age pattern is not significant.

Accident occurrence also varies by farm type, with 46 per cent of dairy farmers having experienced any type of accident, compared to 33 per cent of non-dairy farmers. Finally, land size appears to have a strong effect, with a tendency for more accidents to occur on larger farms. This difference is significant in respect of

farms from 30–50 hectares (42 per cent) and 50–100 hectares (52 per cent) compared to the reference group of those less than 20 hectares.

FIGURE 4.1 FARMERS INVOLVED IN ANY ACCIDENT DEPENDING ON FARMER AND FARM CHARACTERISTICS



*Notes: *indicates a significant difference from the reference category at the p<0.05 level; **indicates a significant difference from the reference category at the p<0.005 level (based on results from a bivariate logit model for each factor, i.e. with no controls.) Note that two proportions may be significantly different even if the confidence intervals for both proportions overlap slightly. See https://www.cscu.cornell.edu/news/statnews/stnews73.pdf for an explanation.*

There were no significant differences depending on farmers' marital status, having children or working full- or part-time.

4.2 FACTORS ASSOCIATED WITH ANY ACCIDENT OR NEAR MISS

Table 4.1 shows results from a model exploring the association between experiencing 'any accident' and farm and farmer characteristics. Overall, the main differences are by farm size and risk taking. Model 1 shows that those farming on larger farms are more likely to have had an accident or near miss when factors including age, having children, farm type and full- or part-time status are controlled (odds ratio of between 2.5 and 3.5 times for those farming 51–100 hectares and over 100 hectares, compared to farmers with land less than 20 hectares). The later models indicate that this pattern remains significant when we control for being in the top decile in terms of risk taking (Model 2) and for those scoring highly on each of the individual risk taking indicators (Model 3).

TABLE 4.1 FACTORS ASSOCIATED WITH ANY ACCIDENT OR NEAR MISS (ODDS RATIOS)

		Model 1	Model 2	Model 3
Age	Age 18–44 vs. 55+	1.18	1.15	1.03
	Age 45–54 vs. 55+	1.12	1.12	1.10
Family	Has children	1.03	1.06	1.14
Size	21–30 ha vs. < 20	1.05	1.00	1.10
	31–50 ha vs. < 20	1.86*	1.82	2.12*
	51–100 ha vs. < 20	2.68**	2.57**	2.86**
	≥ 100 ha vs. < 20	3.63***	3.54***	4.54***
Hours	Part-time vs. full-time	1.23	1.18	1.21
Type farm	Dairy vs. other	1.03	0.99	0.98
Risk taking	Top 10% on risk scale		2.04*	
	Non-use of safety gear			1.08
	Non-use of animal restraint			0.89
	Not checking machinery			2.75*
	Not using PTO guard			0.91
	Improperly storing chemicals			0.85
	Not getting help			2.40**
Constant		0.34**	0.33**	0.22***
N cases		801	801	801

*Notes: Weighted results with robust standard errors (STATA svy). The results come from a logit model where the dependent variable is having experienced any accident of near miss in the past ten years. *** p<0.01, ** p<0.05, * p<0.10.*

Not getting help when dealing with difficult tasks had the biggest impact (odds ratio of 2.4). Note that since the farmers in the study are self-employed with no full-time employees, it may have been difficult for them to call on someone else for help. Not checking machinery was associated with an increased risk that is only of borderline statistical significance (p<0.1), compared to farmers who do

check machinery. This is consistent with findings from Belgium of an association between injury and unsafe use of machinery (Van den Broucke and Colémont, 2011).

The overall risk taking scale was associated with twice the odds of accidents in the sample for those in the top ten per cent on the risky behaviour scale, but this was also of only borderline significance ($p<0.1$).

When controlled for, there was no association between accidents or near misses and any of these characteristics: farmer age; marital status or having children; whether the farmer worked full-time or part-time; or whether or not the farm was a dairy farm.

4.3 FACTORS ASSOCIATED WITH DIFFERENT TYPES OF ACCIDENTS AND NEAR MISSES

The previous model focused on experiencing a combination of any type of accident as an outcome. Now we explore variation across each of the three different accident types: the farmer personally having an accident on the farm; someone else having an accident on the farm; and the farmer personally having a near miss. Two models are shown in Table 4.2: Model 1 examines the association with farmer and farm characteristics and the overall indicator of risk taking, while Model 2 distinguishes the different types of risk taking.

Here, we see again that farm size is the biggest cause of variation, particularly for having experienced a near miss, with the odds of this more than six times as high for farming 100 or more hectares, compared to farming less than 20 hectares, when all the types of risk taking are controlled for. Land size also appears to influence the odds of a farmer actually experiencing an accident but is not a significant factor for someone else having an accident on the farm.

Turning to the relationship between accident type and risk taking, we see that being in the top decile of the overall scale was a factor only for farmers personally experiencing an accident and that this is only marginally significant ($p<=.10$).

When the individual indicators of risk taking are analysed separately, again we find that not checking machinery and not getting help are significant contributors to the occurrence of different types of accident. Not checking machinery is associated with four times the odds of someone other than the farmer having an accident and the chances of the farmer experiencing a near miss. Not getting help increases the odds of the farmer reporting an accident by 2.5 times and a near miss by 2.3 times (with the latter of borderline statistical significance).

TABLE 4.2 FACTORS ASSOCIATED WITH DIFFERENT TYPES OF ACCIDENT OR NEAR MISS (ODDS RATIOS)

VARIABLES		Farmer accident		Other accident		Near miss	
		Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Age	Age 18–44 vs. 55+	0.63	0.57	3.02	2.76	1.52	1.33
	Age 45–54 vs. 55+	1.06	1.03	1.02	0.93	1.91	1.84
Family	Children	0.68	0.65	0.71	0.83	1.04	1.18
Size	21–30 ha vs. <20	1.58	1.85	0.32	0.32	1.37	1.54
	31–50 ha vs. <20	2.26	2.51	0.37	0.39	2.39*	2.94***
	51–100 ha vs. <20	4.15**	4.48**	0.82	0.84	2.98**	3.51***
	100+ ha vs. <20	4.14*	5.12***	1.05	0.99	4.47***	6.15***
Hours	Part-time vs. Full-time	0.65	0.67	0.44	0.38	1.8	1.88*
Type farm	Dairy vs. other	0.80	0.85	0.47	0.45	1.22	1.21
Risk taking	Top 10% risky behaviour	2.54*		2.03		1.71	
	Non-use of safety gear		1.49		1.45		0.77
	Non-use of animal restraint		1.58		0.97		0.56
	Not checking machinery		1.59		4.43**		3.61**
	Not using PTO guard		0.83		0.84		1.11
	Improperly storing chemicals		1.09		0.62		0.70
	Not getting help		2.47**		0.83		2.28*
Constant		0.12**	0.07***	0.16**	0.13***	0.07***	0.07***
N cases		812	812	810	810	807	807

*Note: Weighted results with robust standard errors (Stata svy). The results come from a logit model where the dependent variable is having experienced the different types of accident (to the farmer, to others) or near miss in the past ten years. *** p<0.01, ** p<0.05, * p<0.10*

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As shown previously, no association was found between the occurrence of accidents or near misses and farmer age, having children, farm type and whether the farmer worked full- or part-time.

4.4 SUMMARY

A descriptive account of the link between accidents and farmer and farm characteristics indicated that age did not significantly affect the proportion of farmers reporting any type of accident. Dairy farmers and those with larger farms were more likely to have experienced an accident or near miss on the farm.

The statistical analysis allowed us to identify the most salient factors, controlling for the fact that characteristics of the farmer and farm were correlated. This analysis suggested that farm size and risk taking were the most important predictors of near misses or accidents. Farmers on larger farms were more likely to have had an accident or near miss. Risk taking also had an independent effect

on the likelihood of experiencing some form of accident, of not getting help with difficult tasks, of not checking machinery. Being in the top decile of the overall risk taking scale were all associated with more than twice the odds of experiencing an accident or near miss (although the latter two factors are only marginally significant).

When each of the different accident types were examined separately as outcomes, we found again that farm size and risky work practice were the most salient factors. Farming 100 or more hectares was associated with odds of having had a near miss over six times higher when other factors (including risk taking) were controlled for.

The individual indicators of risk point to a link between not checking machinery and someone other than the farmer having an accident. The farmer experiencing a near miss while not getting help was associated with the farmer personally having had an accident.

Although some of the literature suggested a link between inexperience and the risk of accidents, we were unable to examine this in the statistical models. Level of experience is strongly correlated with farmer age so it was not possible to include both in the statistical models. Moreover, the questions asked about the occurrence of accidents over the previous ten years, so the prevalence of accidents may be underestimated among farmers with less than ten years' experience because they had a shorter period of exposure. In addition, there is no information on how long ago the accident occurred.

In Chapter 3, we examined the association between risk taking and both stress and distress. This is because the literature suggested such an association and it might be reasonable to expect that risk taking would be increased if the farmer was distracted by work-related stress or by distress. We did not examine the association between accidents and either stress or distress, however, because it would be very difficult to say whether the stress and distress were either present as a result of experiencing the accident, or contributed to the accident occurring. This is particularly true given that stress and distress were measured at the time of the interview whereas the accident or near miss might have occurred up to ten years in the past.

CHAPTER 5

Conclusion and implications

5.1 INTRODUCTION

In the context of high fatalities in agriculture, relative to other sectors, this report sought to draw on a 2013 Health and Safety Authority (HSA) survey to examine the factors associated with risk taking on farms and with the occurrence of accidents or near misses. A review of the literature pointed to a number of factors that were likely to be important, including farm size, farmer age, type of farm (with higher risks observed for dairy farms). In revisiting the 2013 HSA farm survey, this study examines risk taking and the experience of accidents and near misses on farms.

The 2013 survey, conducted for the HSA by GL Noble Denton, was completed (in most cases by post) by 836 self-employed farmers who were primarily contacted via the HSA's farm holdings database. It was a random sample, stratified by region, with a response rate of 26 per cent. The questionnaire included items on safe working practices, attitudes to working safely, factors that influence or create barriers to safe working and the occurrence of accidents on the farm. There are also items measuring levels of work-related stress and well-being along with demographic information relating to characteristics of both the farm and the farmer.

The initial report on the survey provided a mainly descriptive analysis, with a particular emphasis on intentions to work safely (HSA, 2014). The present analysis went beyond the earlier work in two respects. Firstly, it reweighted the sample data to better represent the population of all farms in terms of farmer age, farm size and farm type. Secondly, it went beyond descriptive results to conduct a statistical analysis of risk taking and of accident experience designed to isolate the relative importance of related factors such as farmer age and farm size.

The research questions focused on:

- factors associated with risk taking, including characteristics of the farmer (age, marital status, full- or part-time work, number of years farming experience) and of the farm (farm size, farm type);
- variations in work stress factors and levels of distress by farmer and farm characteristics; and
- factors associated with experiencing an accident or near miss, including characteristics of the farmer (age, marital status, full- or part-time work) and of the farm (farm size, farm type) as well as risk taking.

The findings are summarised below, followed by an analysis of their implications for health and safety policy and practices in the agricultural sector.

5.2 RISK TAKING

Six indicators of risk taking were used. Farmers were asked how much of the time they took each of six precautionary measures: using safety gear (such as goggles, ear defenders); using restraining or handling facilities when treating animals; checking that machinery is in good working order; using PTO or guarding with machinery; keeping chemicals stored away from access by children; and getting help with difficult jobs. We take risk taking in each of these areas to involve using the safety measure only 'sometimes' or less often. The most common types of risky behaviour were not getting help with difficult jobs (27 per cent) and not wearing safety gear (26 per cent). About 12 per cent of farmers took risks in not checking machinery before use. Each of the other types of risk was taken by fewer than one in ten of farmer respondents.

An overall indicator identified farmers who were in the highest ten per cent of risk taking across the six types of risk. In this respect, younger farmers were more likely than older farmers to take risks. The same was true of dairy farmers compared to other farmers. Risk taking was lower on the smallest farms. There was no significant association with marital status, having children or working part-time. The statistical model that took account of a number of factors at once pointed to farm type as the main factor, with a higher probability of being a risk-taker on dairy farms. There was also a tendency for the younger farmers to be risk-takers, though this was only of borderline statistical significance when farm type was controlled.

We also examined the different types of risk separately. In a number of respects, middle-aged farmers (45–54 years) showed some tendency to be less likely to be risk-takers than older and younger farmers. This was true regarding non-use of safety gear, non-use of animal restraints and not safely storing chemicals. This group was more likely than older farmers to not use the PTO system on tractors. However, these age-related differences were only of borderline statistical significance ($p<=.10$).

Single farmers were more likely to take risks in not checking machinery before use. In other respects, they did not differ significantly from their married counterparts. In some preliminary analysis, we had established that there were no differences between farmers with and without children when we took account of marital status, age and farm type.

There were statistically significant differences by farm size for two types of risk: those farming a higher number of hectares were more likely to not use safety gear but were less likely to not get help with difficult tasks. For instance, compared to farms under 20 hectares, the odds of not using safety gear were at least twice as high on farms over 50 hectares. On farms over 100 hectares, the odds of not getting help were only one-third as high as those for farms under 20 hectares. Although the farmers in the study did not have any regular employees, it may be that the larger farms have more part-time or seasonal employees. This might account for the greater propensity to get help with difficult tasks (about three times higher than on the smallest farms).

Part-time farmers showed some tendency to have a higher rate of risk taking but this was only statistically significant for improper storage of chemicals, where the odds were nearly four times higher than for full-time farmers. It is also in terms of improper storage of chemicals that dairy farmers stand out, with odds that are over six times higher than those for non-dairy farmers. (As already noted, the overall proportion of farmers taking risks in this respect is low.)

5.3 FARMER DISTRESS AND WORK STRESS

We examined work-related stress and the experience of mental distress because the literature suggested that these may be associated with a greater propensity to take risks. In general, farmers reported low levels of distress and a medium level of concern regarding work issues. Distress was measured using the five-item scale capturing the extent to which the farmer respondent had recently felt cheerful, calm and relaxed, active and vigorous, feeling rested in the morning and that life was filled with things of interest. The scale was coded to range from one (low distress) to five (high distress). The average score was towards the low end of the spectrum at 1.55.

Work-related stress was measured on the basis of level of concern regarding four issues: government regulation and policies, farm paperwork, financial matters and workload. The scale was coded to range from one (low stress) to five (high stress). The average was towards the middle, at 3.35.

Although some previous research had suggested a link between risk taking and stress or distress, we did not see this pattern in the present data for work-related stress, once we controlled for farmer and farm characteristics. Mental distress was associated with a greater likelihood of improperly storing chemicals (i.e. where they might be reached by children), however, and also with a greater likelihood of not getting help with difficult tasks. It should be noted that the overall rate of storing chemicals where they might be reached by children was

very low, however, so even when the risk was higher in relative terms, the large majority of farmers did not take this type of risk. In the case of not getting help, it could be that both mental distress and not getting help are caused by the farmer being relatively isolated. We cannot, therefore, infer a causal relationship between mental distress and risk taking.

5.4 ACCIDENTS AND NEAR MISSES

Three indicators of the occurrence of accidents or near misses on a farm over the previous ten years were identified: whether the farmer had personally been involved in an accident on the farm, whether someone else had been involved in an accident on the farm and whether the farmer had been involved in a near miss or 'lucky escape' on the farm. Where an accident actually occurred, in about half of cases, it resulted in injury leading to four or more days' absence from work. (By the very nature of the survey methodology, fatal accidents involving the farmer would not be covered.)

We conducted a series of statistical analyses to examine the association between farmer and farm characteristics, including risk taking, and the experience of accidents.

Turning first to the experience of any accident or near miss, the only significant association was with farm size. An accident or near miss was more likely to occur on a larger farm than a smaller one. For instance, the odds of an accident or near miss were over three times higher on a farm of more than 100 hectares than on a farm of less than 20 hectares. This pattern remained statistically significant when risk taking was taken into account, with the relationship tending to be even stronger (odds more than four times higher for the largest than the smallest farms).

Risk taking was associated with a higher probability of having experienced an accident or near miss, but the only statistically significant relationship was with not getting help with difficult tasks. The odds of having an accident or near miss were over twice as high for those who do not get help than for those who do. There was also a higher risk in the sample associated with not checking machinery, but we cannot be sure this reflects a pattern in the general population of farmers.

Having had an accident or near miss was more likely among young farmers and part-time farmers, but the pattern was weak and not statistically significant.

We then looked separately on accidents or near misses involving the farmer himself and those accidents involving others. Farmer accidents and near misses were both associated with larger farms but there was no significant association with farm size in the case of accidents involving others. In terms of safety practices, we saw that not getting help was more strongly associated with an accident involving the farmer than accidents involving others. Not checking machinery was significantly associated with accidents involving others and near misses.

5.5 LIMITATIONS AND FUTURE RESEARCH

Behaviour is likely to have changed in response to an accident or near miss. This means that the observed association between the experience of accidents and risk taking will be weaker than if we had a measure of behaviour before the accident. As a result, the associations in the data between risk taking and accidents are likely to represent the lower bound estimate of the strength of the causal relationship.

Because the sample departed from the structure of the population of farms in many respects, including farmer age, farm size and type, we needed to apply sample weights and use the correct techniques to analyse the weighted data. This led to a considerable loss of power when it came to statistical tests. As a result, many of the patterns we saw in the sample could not be generalised to the population. In other words, even differences that seemed quite marked in the sample were not statistically significant. The correction to a biased sample using weights comes at a cost. The standard errors are larger, the confidence intervals are wider and only large differences can be detected as statistically significant.

In future research on farms or other workplaces, when the intention is to generalise the results to all farms or workplaces, this loss of statistical power from a biased sample should be kept in mind.

One issue we could not explore in the current survey was the impact of inexperience on farm safety. This was affected by the very long reference period for farm accident experiences (ten years) and the small size of the group that had recently begun farming. The period of exposure to farm work for young farmers might well be less than ten years, but without information on when the accident occurred we could not make an adjustment for period of exposure.

5.6 POLICY DISCUSSION

5.6.1 Help with difficult tasks

The results indicated that over one-quarter of farmers (27 per cent) do not routinely get help with difficult tasks. This practice is associated with an increased risk of having an accident. Getting help may be done informally, by asking a family member, friend or neighbour, or more formally by hiring someone for the job. Given the solitary nature of much farm work, there is clearly a need for a system for calling on additional help where there is a difficult task to be accomplished. The issue seems to be particularly pressing on the smaller farms and is also associated with high levels of mental distress. As a result, failure to get help may be related to the capacity to afford to hire help or with farming in relatively isolated circumstances, or both. More information would be needed on the type of task involved and on its frequency in order to develop more specific recommendations in this area. The results of this report point to this as a potentially important factor in farm safety.

5.6.2 Checking machinery

About one farmer in eight does not routinely check machinery before use and this practice is associated with an increased risk of accidents involving others, as well as near misses involving the farmer. This finding could continue to be emphasised in safety messages directed towards farmers.

5.6.3 Younger farmers

Younger farmers were more likely to take risks. Although the statistical model suggested that this was due to the association between age and other characteristics such as farm size and type, the age pattern is consistent with more general findings on a higher risk of workplace injury among younger workers. It points to the need to have safety messages directed towards younger farmers in areas such as use of safety gear, using animal restraints and properly storing chemicals. Single farmers, who tend to be young, were also more likely to take risks in not checking machinery. Since young farmers are more likely to have taken formal agricultural training courses, these aspects of health and safety might receive even stronger emphasis as part of their training.

5.6.4 Dairy farms

Dairy farmers were more likely to take risks, particularly when it comes to not storing chemicals out of reach of children. It is worth continuing to emphasise safety in this respect among dairy farmers.

5.6.5 Larger farms

The only form of risk taking that increased with farm size involved not using safety gear. A possible explanation is that the safety gear is not near to hand because of the larger farm size. In this case, it may be worth promoting methods for ensuring that safety gear is available where it is needed.

Even with risk taking controlled, the incidence of accidents or near misses was greater on large farms. This is an area worthy of further research. In particular, is the work pressure on larger farms leading to a faster pace of work that is contributing to accidents, even where the specific safety precautions are taken?

5.6.6 Dissemination strategies

It is worth expanding the means of disseminating safety messages to farmers. One way might be to make use of the discounts offered by many insurance companies to farmers who adopt certain safety practices, including having a farm safety statement. Having a farm safety statement or risk assessment document is required by law (The Safety, Health and Welfare at Work Act, 2005), but linking it to the application for renewal of farm insurance is a potential way to reinforce the content of the statement. The completion of a checklist before commencing or renewing an insurance policy is a potentially useful tool to raise awareness of the issues that have emerged as important here.

Other strategies to enhance the dissemination of information about farm safety might include linking insurance discounts to participation in a farm safety 'refresher' course and producing summaries of research findings in an accessible, non-technical format (as is planned for this report).

REFERENCES

CSO (2008). *Farm structure survey 2007*, Stationery Office, Dublin.

CSO (2012). *Census of agriculture 2010 – Final results*, Stationery Office, Dublin.

CSO (2014). *Farm structure survey, 2013: Key findings*, available at http://www.cso.ie/en/releasesandpublications/ep/p-fss/farmstructuresurvey2013/keyfindings, accessed 24 May 2016.

CSO (2015). *Statistical release 25 June*, available at http://www.cso.ie/en/releasesandpublications/er/qnhs-es/qnhsemploymentseriesq12015 accessed 19 September 2016.

CSO (2016). *QNHS principle statistics*, available at http://www.cso.ie/multiquicktables/quickTables.aspx?id=qnq03, accessed 23 May 2016.

Davies, R. and P. Jones (2005). *Trends and context to rates of workplace injury*, Research Report 386, Health and Safety Executive (UK).

Deary, I.J., J. Willock and M. McGregor (1997). 'Stress in farming'. *Stress Medicine*, Vol. 13, pp. 131–136.

Dembe, A.E., J.B. Erickson, R.G. Delbos and S.M. Banks (2005). 'The impact of overtime and long work hours on occupational injuries and illnesses: New evidence from the United States', *Occupational and Environmental Medicine*, Vol. 62, No. 9, pp. 588–597.

Finnegan, A. and J. Phelan (2003). *A survey of health and safety on Irish farms: Implications for extension and education*, Paper presented at the 19th annual Conference of the Association for International Agricultural and Extension Education (AIAEE), Raleigh, North Carolina, USA, available at https://www.aiaee.org/attachments/article/1212/Finnegan271.pdf, accessed 19 September 2016.

Furey, E.M, D. O'Hora, J. McNamara, S. Kinsella and C. Noone (2016). 'The roles of financial threat, social support, work stress, and mental distress in dairy farmers' expectations of injury'. *Front. Public Health*, Vol. 4, p. 126.

Health and Safety Authority (HSA) (2014) 'Determining underlying psycho-social factors influencing famers' risk-related behaviours in the Republic of Ireland'. Completed by G.L. Noble Denton for the Health and Safety Authority, Ireland, Dublin.

Health and Safety Authority (HSA) (2016). *Summary of workplace injury, illness and fatality statistics 2014–2015*, HSA, Dublin, available at http://www.hsa.ie/eng/Publications_and_Forms/Publications/Corporate/HSA_Statistics_Report_2014-2015.pdf, accessed 19 September 2016.

Knowles, D. (2002). *Risk perception leading to risk taking behaviour amongst farmers in England and Wales*, ADAS Consulting Ltd and the Health and Safety Executive (UK).

Kolstrup, C.L., M. Kallioniemi, P., Lundqvist, H-R., Kymäläinen, L., Stallones and S. Brumby (2013). 'International perspectives on psychosocial working conditions, mental health, and stress of dairy farm operators'. *Journal of Agromedicine*, Vol. 18, No. 3, pp. 244–255.

Landen, D.D. and S. Hendricks (1995). 'Effect of recall on reporting of at-work injuries'. *Public Health Reports*, Vol. 110, No. 3, pp. 350–354.

McCurdy, S.A. and D.J. Carroll (2000). 'Agricultural Injury'. *American Journal of Industrial Medicine*, Vol. 38, pp. 463–480.

McNamara, J., (2012) *Presentation paper at health and safety conference*, Cork, available at https://www.teagasc.ie/publications/?page=20&yearReleased=2012, accessed 19 September 2016.

McNamara, J. and K. Reidy (1997). *A survey of farm safety and health on Irish farms*, a study carried out by TEAGASC on behalf of the Health and Safety Authority, Teagasc, Dublin.

Murphy, D.J. (1981). 'Farm safety attitude and accident involvement'. *Accident Analysis and Prevention*, Vol. 13, No. 4, pp. 331–337.

Napier, T.L., W.R. Goe and A.R. Pugh (1985). 'Incidence and predictive factors associated with farm accidents in Ohio'. *Research Circular of the Ohio Agricultural Research and Development Center,* Vol. 287, pp. 1–15.

Rautiainen, R.H., J.L. Lange, C.J. Hodne, S. Schneiders, and K.J. Donham (2004). 'Injuries in the Iowa certified safe farm study'. *Journal of Agricultural Safety and Health*, Vol. 10, No. 1, pp. 51–63.

Roberts, R.E. and E.S. Lee (1993). 'Occupation and the prevalence of major depression, alcohol, and drug abuse in the United States'. *Environmental Research*, Vol. 61, pp. 266–278.

Roy, P., G. Tremblay and S. Robertson, S. (2014). 'Help-seeking among male farmers: Connecting masculinities and mental health'. *Sociologia Ruralis*, Vol. 54, No. 4, pp. 460–476.

Russell, H., B. Maître and D. Watson, D. (2015). *Trends and patterns in occupational health and safety in Ireland*, ESRI, Dublin.

Sanne, B., A. Mykletun, B.E. Moen, A.A. Dahl and G.S. Tell (2004). 'Farmers are at risk for anxiety and depression: The Hordaland Health Study'. *Occupational Medicine*, Vol. 54, pp. 92–100.

Simpson, K., R. Sebastian, T.E. Arbuckle, C. Bancej and W. Pickett, W. (2004). 'Stress on the farm and its association with injury'. *Journal of Agricultural Safety and Health*, Vol. 10, No. 3, pp. 141–53.

Solomen, C. (2002). 'Accidental injuries in Agriculture in the UK'. *Occupational Medicine*, Vol. 52, pp. 461–466.

Sprince, N.L., H. Park, C. Zwerling, C.F. Lynch, P.S. Whitten, K. Thu, L.F. Burmeister, P.P. Gillette and M.C.R. Alavanja (2003). 'Risk factors for

animal-related injury among Iowa large-livestock farmers: A case-control study nested in the Agricultural Health Study.' *The Journal of Rural Health*, Vol. 19, No. 2, pp. 165–173.

Sprince, N.L., H. Park, C. Zwerling, C.F. Lynch, P.S. Whitten, K. Thu, P.P Gillette, L.F. Burmeister and M.C.R. Alavanja (2002). 'Risk factors for machinery-related injury among Iowa farmers: A case-control study nested in the Agricultural Health Study'. *International Journal of Occupational and Environmental Health*, Vol. 8, No. 4, pp. 332–338.

StataCorp (2013a). *Stata: Release 13. Statistical Software*, College Station, TX. StataCorp LP.

StataCorp (2013b). *Stata survey data reference manual, Release 13*, College Station, TX. StataCorp LP.

Teagasc (2013). *National Farm Survey Results 2013*, available at https://www.teagasc.ie/rural-economy/rural-economy/national-farm-survey/national-farm-survey-results/2013/, accessed 20 September 2016.

Thompson, S.K. (2012) *Sampling*. 3rd ed., Wiley, Hoboken, NJ.

Van den Broucke, S. and A. Colémont (2011). 'Behavioral and nonbehavioral risk factors for occupational injuries and health problems among Belgian farmers'. *Journal of Agromedicine*, Vol. 16, pp. 299–310.

Virtanen, S.V., V. Notkola, R. Luukkonen, E. Eskola and K. Kurppa (2003). 'Work injuries among Finnish farmers: A national register linkage study 1996–1997'. *American Journal of Industrial Medicine*, Vol. 43, pp. 314–325.

Wallis A. and M.F. Dollard (2008). 'Local and global factors in work stress: The Australian dairy farming examplar'. *SJWEH Suppl*., Vol. 6, pp. 66–74.

Warner, M., N. Schenker, M.A. Heinen and L.A. Fingerhut (2005). 'The effects of recall on reporting injury and poisoning episodes in the National Health Interview Survey'. *Injury Prevention,* Vol. 11, No. 5, pp. 282–287.

Williams, B. (1978). *A Sampler on sampling*, Wiley, New York.

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